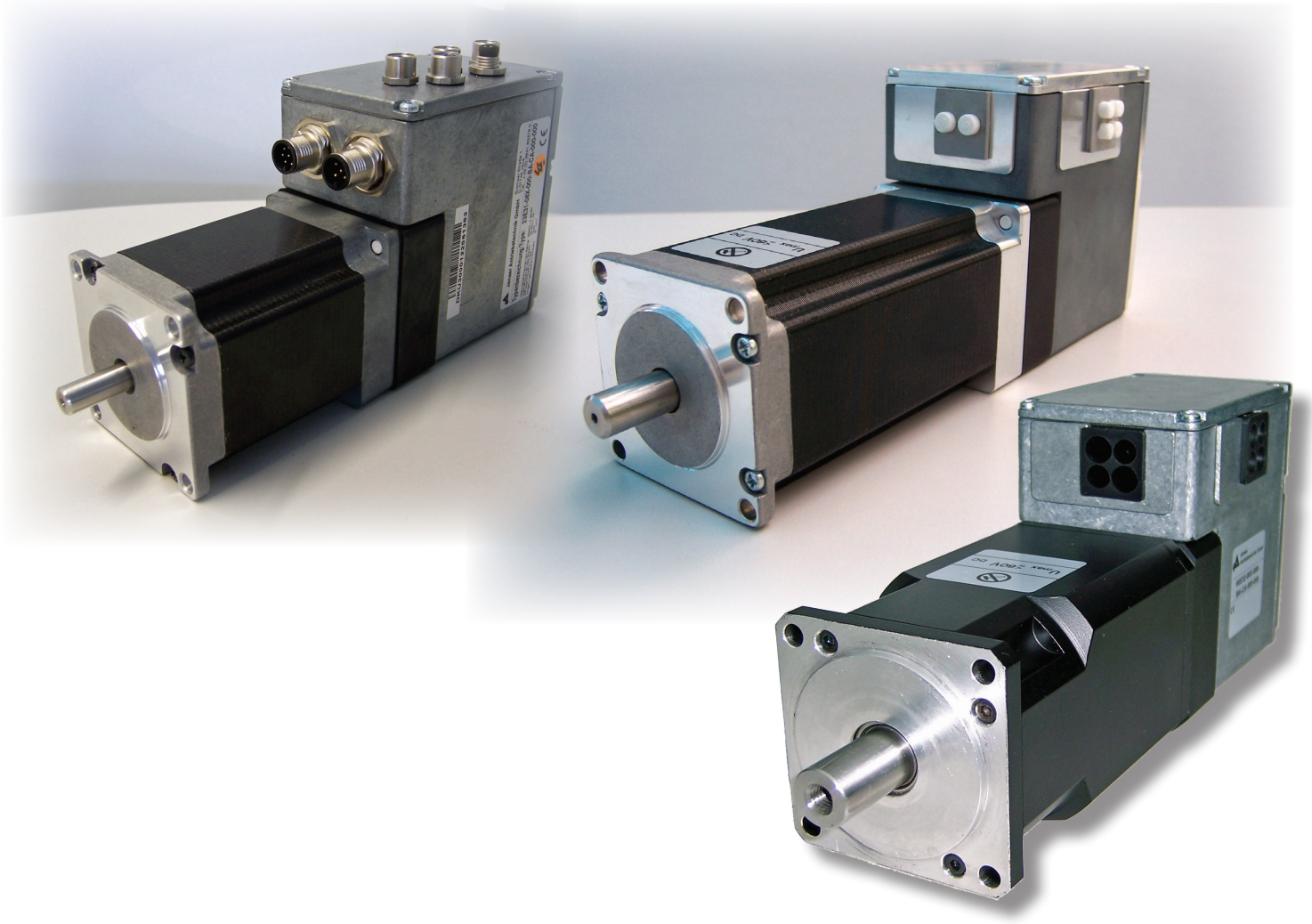
Jenaer Antriebstechnik GmbH

EtherCAT®

CANopen®



User Manual **ECOMPACT® 23E/60E**

Published editions:

Edition	Comment
Feb. 2009	Preliminary English edition (prototype deliveries)
April 2009	Pre-series
Nov. 2009	Series
March 2011	ECOMPACT 60E32, option IP54
June 2011	Correction of assignment XS7
Dec. 2012	M8/M12 connector option, modified dimensions
April 2013	EtherCAT® interface option added
Jan. 2014	Modified ordering key
March 2014	Note on the operation of the DIP switches added
Nov. 2014	Correction of wire colours of XS7, designation DIN1

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Buchaer Straße 1
07745 Jena

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The content of this document has been worked out and checked carefully. Nevertheless differences from the real state of the hard and software can never be fully excluded. Necessary corrections will be carried out in the next edition.

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1 About this manual

This installation manual describes the compact servo drive ECOMPACT®. It concerns all persons who project, install and commission ECOMPACT® drives.

Further information:

- Software commissioning: ECO Studio Operation Manual ECOVARIO®, ECOSTEP®, ECOMPACT®
- Parameterization: ECO Studio Operation Manual ECOVARIO®, ECOSTEP®, ECOMPACT®
- Application Notes ECOMPACT®

This manual makes the following demands on qualified personnel:
Transport: Personnel trained in handling electrostatic sensitive devices
Installation: Electrotechnically qualified personnel who know the security directives of electrical engineering and automation
Setup/Commissioning: Qualified personnel with a broad knowlege of the fields of electrical engineering, automation and drives.

2 Safety instructions

2.1 Symbols

Table 2.1: Symbols

Pictogram	Warning	Consequences
	General warning about danger	Disregarding this warning may lead to death or serious injuries.
	Warning about dangerous electrical voltages	Disregarding this warning may lead to death or serious injuries.
	Warning about hot surfaces	Disregarding this warning may lead to burns to the skin.

2.2 General safety instructions

Table 2.2: General safety instructions

	The compact servo drives are components which are built into machines and can only be used as integral components of such equipment. Setting the compact servo drive into operation is forbidden until it has been established that the machine or plant fulfils the requirements of the EC Machinery Directive 2006/42/EC.
	Only properly qualified personnel are permitted to perform activities such as transport, installation, setup and maintenance of the product. The qualified personnel must know and observe all relevant safety standards.
	In case of modifications or retrofits with components of manufacturers other than Jenaer Antriebstechnik, please contact us to clarify that those components are suitable to be assembled with our devices.
	The operating conditions have to accord to the data on the nameplate.
	Emergency-off equipment must be workable in all operation modes, especially during setup and maintenance.

2.3 Installation

Table 2.3: Safety instructions, installation

	On coupling the motor it is important to pay attention to the exact orientation of the shaft. A too big misalignment leads to vibrations, reduction of torque and lessens the working life of the bearings. Always avoid a mechanically overdefined bearing of the shaft.
	On mounting drive elements onto the free shaft end, watch the safe radial and axial stress of the shaft. Never use a hammer or a similar tool for mounting. Protect the drive elements from loosening.
	When using a belt drive watch the safe radial stress of the motor shaft.
	Make sure the compact servo drive is properly ventilated. If ambient temperatures higher than 40 °C occur contact the manufacturer.

2.4 Electrical connection

Table 2.4: Safety instructions, electrical connection

	The compact servo drives are **not** intended for direct connection to the power supply system but have to be driven with an electronic converter. Connecting the motor directly to the power supply system leads to destruction of the motor.
	All work may only be carried out by qualified personnel. The machine or plant has to be switched off and protected against restart.
	Before applying a voltage it is vital to make sure that the protective earth conductor is connected properly. Observe the data on the name plate.
	During operation control and power connections lead dangerous voltages. Never loosen connections if they are live.
	After disconnecting the device wait at least 3 minutes before touching the contacts. Capacitors can still have dangerous voltages present up to 3 minutes after switching off the supply voltage. To be sure measure the DC link voltage and wait until it has fallen below 40 V.

2.5 During operation

Table 2.5: Safety instructions, operation

	The surfaces of the motors can get hotter than 70 °C. Therefore they have to be protected against touching. No temperature sensitive parts may touch the surface or be fastened to them.
	Unintentional movements of motors, tools or axes may lead to death or serious injuries. ECOMPACT® drives can produce strong mechanical powers and high accelerations. Avoid staying in the danger zone of the machine. Never switch off safety equipment, not even for test operation! Malfunctions should be repaired by qualified personnel immediately.

2.6 Prescribed use

All notes about technical data and ambient conditions have to be observed.
Using the unit in hazardous locations and in ambients containing oil, gas, vapours, dusts, radiations etc. is prohibited if it is not explicitly allowed due to special measures.
The manufacturer of the machine must generate a hazard analysis for the machine and take appropriate measures to ensure that unforeseen movements cannot cause injury or damage to any person or property.

If one or more ECOMPACT® are built into machines or plants the intended operation of the whole machine or plant is forbidden until it has been established that the machine or plant fulfills the requirements of the EC Machinery Directive 2006/42/EC and the EMC Directive 2004/108/EC. Further EN 60204 and EN ISO 12100 parts 1 and 2 have to be observed.

3 Legal notes

3.1 Terms of delivery

Our terms of delivery are based on the „The General Terms of Delivery for Products and Services of the Electrical Industry“ (German: ALB ZVEI) of the Central Association of the Electrical and Electronics Industry (ZVEI e.V.) in their current version.

3.2 Liability

The circuits and procedures in this manual are proposals. Every user has to check the suitability for every special case. Jenaer Antriebstechnik GmbH is not responsible for suitability. Especially Jenaer Antriebstechnik is not responsible for the following damage causes:

- disregarding the instructions of this manual or other documents concerning ECOMPACT®
- unauthorized modifications of drive, motor or accessories
- operating or dimensioning faults
- Improper use of the ECOMPACT® components

3.3 Standards and directives

ECOMPACT® compact servo drives are components intended to be built into machines or plants for industrial purpose. The devices meet the following standards:

Directive 2006/95/EC „Low Voltage Directive“
Applied harmonized standards:

DIN EN 60 204-1/VDE 0113-1: „Safety of machinery – Electrical equipment of machines – General requirements“

DIN EN 61800-5-1: „Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety requirements; Electrical, thermal and energy“

Directive 2004/108EC „EMC directive“
Applied harmonized standards:

DIN EN 61 800-3: „Adjustable speed electrical power drive systems - EMC requirements and specific test methods“

3.3.1 CE conformity

Compact servo drives ECOMPACT® are components that are intended to be built into electrical plant and machines for industrial use. The manufacturer of the machine is responsible that the machine or plant fulfills the requirements of the EMC directive. The compact servo drives ECOMPACT® have been tested by an authorized testing laboratory in a defined configuration with the system components which are described in this documentation. Any divergence from the configuration and installation described in this manual means that you will be responsible for carrying out new measurements to ensure that the regulatory requirements are fulfilled.

Jenaer Antriebstechnik GmbH

Buchaer Straße 1 · 07745 Jena · Germany
Tel. +49 (0) 3641 6 33 76 55
Fax. +49 (0) 3641 6 33 76 26

Declaration of Conformity

We, the company

Jenaer Antriebstechnik GmbH
Buchaer Straße 1
07745 Jena
Germany

declare the conformity of the product

Designation:	Compact Servo Drive
Type:	ECOMPACT®23E21XX ECOMPACT®23E31XX ECOMPACT®23E41XX ECOMPACT®60E32XX

with the following directives:

EC Directive 2004/108/EC:	(EMC Directive)
Applied harmonized standards:	EN 61800-3 (EMI Disturbance) EN 61800-3 (EMI Immunity)
EC Directive 2006/95/EC:	(Low Voltage Directive)
Applied harmonized standards:	EN 61800-5-1 EN 60204

Issued by:	Jenaer Antriebstechnik GmbH Dipl.-Ing. (FH) Stephan Preuß General Manager
Place, date:	Jena, 14.09.2010
Legally binding signature:	

This declaration does not guarantee specific features.

4 Technical Data

4.1 Equipment

Motor:
The ECOMPACT® is available with two different motor types:

- with encoder commutated multi-pole synchronous motor -> ECOMPACT® series 23E
- with low-pole AC servo motor -> ECOMPACT® series 60E.

The ECOMPACT® 23E is equipped with a high dynamic 2-phase encoder commutated synchronous motor with 56,2 mm flange (NEMA23). The ECOMPACT® 23E is available in three versions, as 23E21 with a peak torque of 1.15 Nm, as 23E31 with a peak torque of 2.15 Nm and as 23E41 with a peak torque of 3.2 Nm. ECOMPACT® series 23E drives are well-suited as direct drives. In this case, a gear unit normally is not necessary, the drive is space-saving, more precise and cost-effective.
The ECOMPACT 60E is suitable for higher speeds (rated speed 3500 rpm).

Encoder:
The ECOMPACT® is equipped with an integrated high resolution incremental encoder (128,000 increments per revolution). As an option, an absolute value encoder is available.

Servo amplifier:
The integrated servo amplifier provides the digital torque, force, speed and positioning control. The supply voltage of the power stage is max. 60 V_{DC}. The drive can be controlled and parameterized via the CAN-open interface. As an option, a version with EtherCAT® interface can be provided. For control purposes furthermore 5 digital 24-V-inputs and 2 digital outputs are available. 2 inputs and 2 outputs are isolated.

Holding brake:
As an option, the ECOMPACT® 23E can be equipped with a braking module. The activation of the holding brake is done automatically.

4.2 Ordering key

Table 4.1: Ordering key ECOMPACT® 23E

23Exx	-	x	xx	-	x	x	x	-	x	x	-	x	x	-	xxx	xxx
																No. of parameter set (three digits)
																No. of firmware (three digits)
															Approvals	
															A: CE, standard design	
															B - I: CE, special design	
														Type of field bus		
														C: CAN		
														P: EtherCAT		
												Options				
												A: 2 x restart lock (redundant, standard), 1 x free usable digital output				
												B: 1 x restart lock, 1 x free usable digital input 2 x free usable digital output (Option)				
												C: 2 x restart lock (redundant), 2 x free usable digital outputs				
										Supply						
										B: DC, power supply 24 ... 60 V; logic supply 24 V						
								Specialties, mountings, customer versions								
								Consecutive numbers								
						0 = no further option – standard device without mechanical modifications B = drilling G = gear (detailed implementation at the end of the ordering key, e.g. PLE60-5) K = short motor shaft (< 20.6 mm) L = long motor shaft (> 20.6 mm) P = feather key acc. to DIN 6885 S = special feather key W = other shaft machining (special diameter, surface, internal thread, etc.)							
					0 = cable feed-through – standard device without modifications A = cable gland C = connector version M8/M12 K = customer version (replaces the nomenclature for options)											
				Encoder type												
				8X: Incremental encoder, max. resolution 128.000 Inc/rev												
				DS: Absolute value encoder, resolution 17 bit singleturn												
				7W: Absolute value encoder, resolution 17 bit singleturn, 12 bit multiturn												
			Brake													
			0: without brake													
			B: braking module 1.5 Nm mounted													
		Motor type														
		23E21: Characteristics see Table 4.6 and Fig. 4.1														
		23E31: Characteristics see Table 4.6 and Fig. 4.2														
		23E41: Characteristics see Table 4.6 and Fig. 4.3														

Example: ECOMPACT® 23E31-08X-000-BA-CA-000-000:
ECOMPACT® compact servo drive with:

- Incremental encoder, max. resolution 128.000 Inc/rev
- DC supply
- Two Enable inputs
- CAN interface
- CE approval, standard design.

ECOMPACT® 60E is available in the configuration **ECOMPACT® 60E32-08X-000-BA-CA-000-000**:
Incremental encoder, max. resolution 128.000 Inc/rev
DC supply
Two Enable inputs
CAN interface
CE approval, standard design.
(Characteristics see Table 4.6 and Fig. 4.4)

4.3 Electrical Data

Table 4.2: Electrical data, power supply

Symb.		Unit	23E21	23E31	23E41	60B32
DC supply						
U_n	Rated supply voltage at DC input XS5 or XS6	V_{DC}	60 (24 ... 60)			
I_n	Rated current (per phase) (ED 100%)	A_{RMS}	3.3	3.4	1.8	3.9
I_0	Stall current (per phase) (ED 100%)	A_{RMS}	5.6	4.4	3.7	4.25
P_{Vn}	Rated losses	W	20	20	20	20

Table 4.3: Electrical data, motor characteristics

Symb.		Unit	23E21	23E31	23E41	60E32
k_T	Torque constant	Nm/A	0.16	0.19	0.54	0.11
k_E	Voltage constant	$V/1000min^{-1}$	8.4	9.9	28.3	6.5
	Isolation class		B, 130°C			

Table 4.4: Electrical data, control signals

Qty.	Control signal	Unit	
1	24-V supply (current consumption without outputs)	V	24 ±10 %
		A	0.8
5	Digital control signal inputs (2 inputs isolated)	V	LOW 0 – 7, HIGH 12 – 36
		mA	10 (at 24 V)
3	Digital control signal outputs (2 outputs isolated)	V	24
		A	0.2

Table 4.5: Electrical data, external fuses

DC supply	5 A (time-lag)
24 V supply	3 A (time-lag)

4.4 Mechanical data

Table 4.6: Mechanical data, dimensions and weight

Dimensions and weight	Unit	23E21	23E31	23E41	60E32
Dimensions W x H x T	mm	cf. drawings in Fig. 5.1			
Weight of unit	kg	1.55	1.75	2.50	2.20

Table 4.7: Mechanical data, rated values

Symb.		Unit	23E21	23E31	23E41	60E32
M_p	Peak torque (ED)	Nm	1.15 (40%)	2.15 (40%)	3.20 (40%)	1.00 (15%)
M_0	Stall torque (ED 100%)	Nm	0.77*	1.20	2.20	0.50
M_n	Rated torque (ED 100%)	Nm	0.40*	0.67	0.98	0.43
n_n	Rated speed	min^{-1}	1000	1000	1000	3500
J_M	Motor inertia	kgm^2x10^{-3}	0.026	0.046	0.069	0.01
F_A	Max. axial load	N	80			110
F_R	Max. radial load	N	100			220
F_{MA}	Max. axial load during assembly	N	150			400
	* preliminary values					

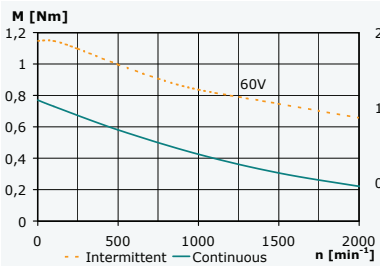


Fig. 4.1: Characteristics 23E21

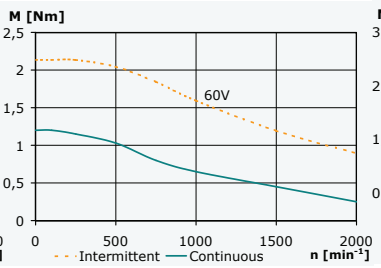


Fig. 4.2: Characteristics 23E31

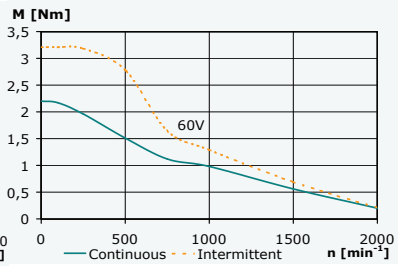


Fig. 4.3: Characteristics 23E41

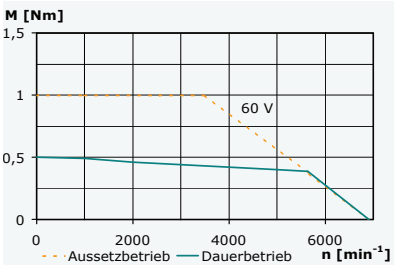


Fig. 4.4: Characteristics 60E32

4.5 Ambient conditions

Table 4.8: General technical data, ambient conditions

Ambient conditions			
ECOMPACT® is designed for ambient conditions of class 3K3 following EN 50178.			
Symb.	Condition	Unit	
T_A	Ambient temperature during operation with nominal load	°C	5 – 40
	Storage temperature	°C	-10 – 70
	Degree of humidity (not condensing)	% rel. F.	5 – 95 (RH-2 nach IEC-61 131-2)
	Cooling		via motor flange and convection
h	Installation altitude	m	up to 1 000 without restriction of power
	Installation position		any
	Protection class		IP40

Table 4.9: General technical data, applicable standards

Noise immunity	acc. to EN61800-3
Noise emission	acc. to EN61800-3
CE safety	acc. to EN61800-5-1

5 Installation

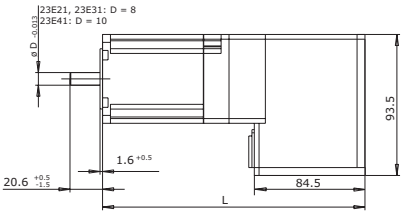
5.1 Mechanical Installation

5.1.1 Important notes

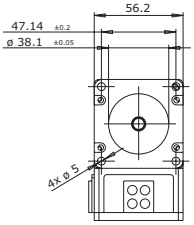
- Make sure that transport and storage did no damage to the units.
- Depending on the power losses a sufficient convection is necessary
- The minimum bending radii of the connecting cables (cf. chapter 9.2) must be observed.

5.1.2 Dimensions

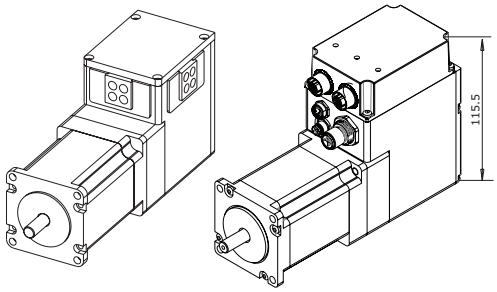
ECOMPACT Series 23E:



23E21 without braking module L = 142.5
23E21 with braking module L = 186.4
23E31 without braking module L = 164.5
23E31 with braking module L = 208.4
23E41 without braking module L = 189.5
23E41 with braking module L = 233.4

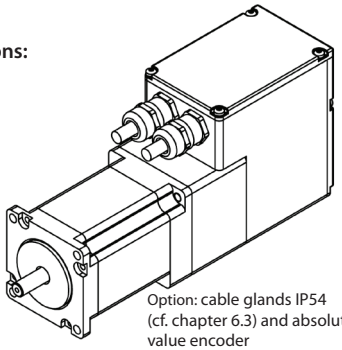


All lengths with incremental encoder.
With absolute value encoder, length increases by 20 mm.

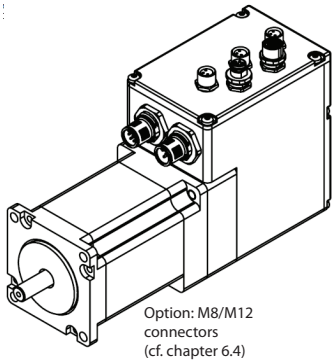


With option EtherCAT interface:
Height increases to 115.5 mm.

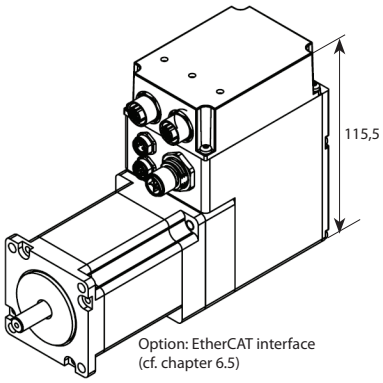
Options:



Option: cable glands IP54
(cf. chapter 6.3) and absolute value encoder

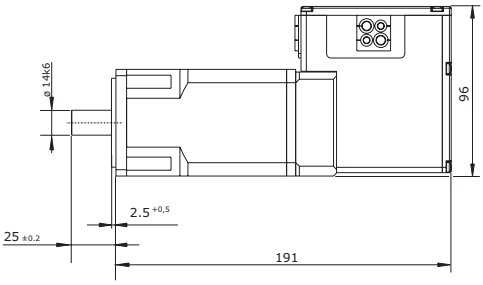


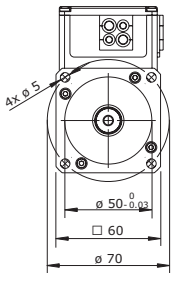
Option: M8/M12 connectors
(cf. chapter 6.4)

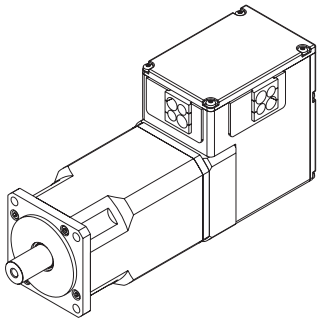


Option: EtherCAT interface
(cf. chapter 6.5)

ECOMPACT Series 60E:







All length specifications with incremental encoder.

Fig. 5.1: Dimensions of the ECOMPACT®

5.1.3 Mounting

ECOMPACT® is intended for the following mounting positions:

- drive shaft horizontal
- drive shaft vertical, shaft end downwards
- drive shaft vertical, shaft end upwards

A sufficient heat dissipation has to be observed. The surface temperature of the motor must not exceed 70°C. If the drive is operated at its limit a sufficient heat dissipation via the motor flange has to be ensured.

The motor flange has to be mounted on a plain surface. A good thermal and electrical connection has to be observed. Varnished surfaces should be avoided. The motor is mounted by means of 4 M5 screws. For reasons of the electromagnetic compatibility (EMC) proper grounding of the ECOMPACT® is required. In the basic version of the ECOMPACT, this is achieved by connecting the protective earth (PE) conductor of the voltage supply to the earthing lug in the cable connection area (cf. Fig. 5.2) and the conductive mounting of the motor flange. The ECOMPACT version with M8/M12 connectors provides the PE pin on the „Power“ connector.

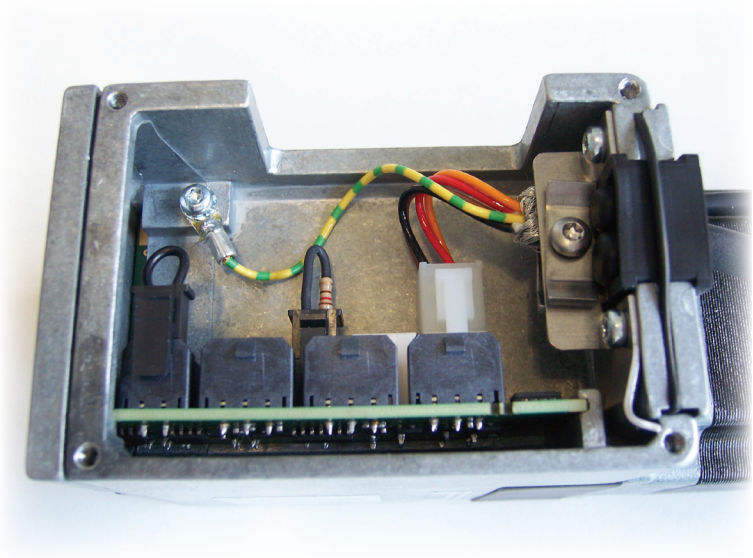


Fig. 5.2: Earthing lug in the cable connection area of the ECOMPACT®

When mounting the ECOMPACT® into a machine make sure that the CAN bus cables and the Enable cables are laid EMC conform by connecting the cable shield extensively via the screening clamps to chassis earth on both sides.

To calculate the minimal mounting space the minimum bending radii of the connecting cables (cf. Chap. 9.2) have to be regarded.

5.2 Electrical Installation

5.2.1 Important notes

All installation work may only be carried out if the machine or plant is not live and protected against re-start.
Never exceed the maximum rated voltage of 60 V_{DC} (+10 %) at the connector XS5 or XS6 (or as an option at the M12 connector „Power“)!

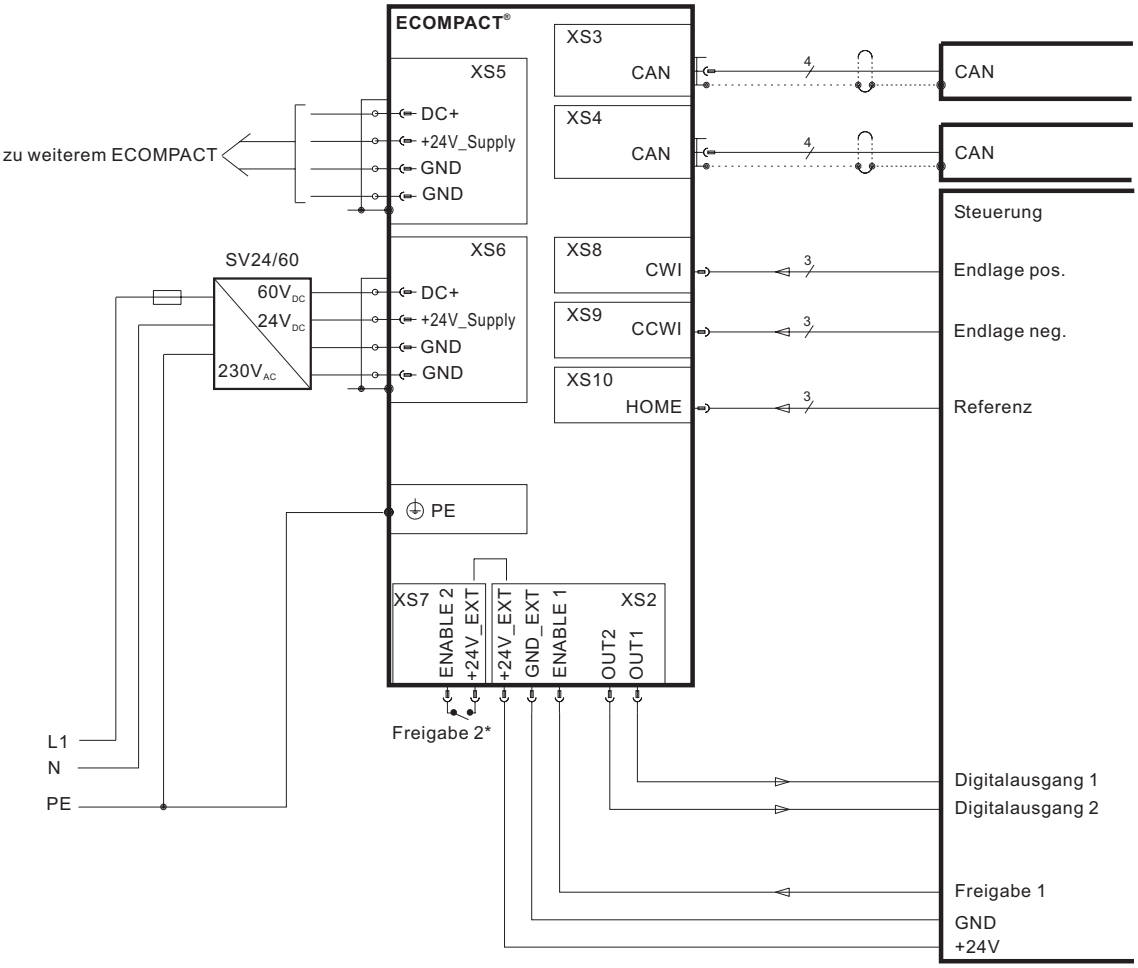
Fusing of the DC supply and of the 24-V logic supply should be carried out by the user. The compact servo drive has to be properly grounded. The protective earth connector must have at least the same diameter as the supply cables.

5.2.2 EMC compliant installation

The supply connection of the machine should be equipped with an appropriate RFI suppression filter. Always use shielded cables.
Metal parts in the cabinet have to be interconnected extensively and conductive regarding HF. Used relays, contactors, solenoids etc. have to be protected against overvoltage. Supply cables and motor cables must be laid in a proper distance of control cables.

5.2.3 Connection diagram

The following diagram shows a connection example of the ECOMPACT® basic version (CAN) with external logic supply 24 V_{DC} and power supply 60 V_{DC}. In this example power supply module SV24/60 is used. Dependent on the resulting power consumption it is possible to supply several ECOMPACT® by means of one power supply module. A concatenation of compact servo drives is possible up to an overall power consumption of 480 W (with an 8 A fuse, medium time-lag).



*) Optional kann XS7 auch als frei verwendbarer Digitaleingang ausgeführt sein (ECOMPACT-xxExx-xxx-xxx-B**B**-...)

Bild 5.3: Connection diagram ECOMPACT® basic version with SV24/60

6 Interfaces

6.1 Available interfaces

By default, the ECOMPACT® provides interfaces for 5 digital inputs, 2 digital outputs, a CAN bus interface, power supply +24 ... +60 V_{DC}, logic supply +24 V_{DC}.

As options are available:

- A version with protection class IP54.Here, the CAN bus interface (incoming and outgoing), power supply +24 ... +60 V_{DC}, and logic supply +24 V_{DC} are provided via cable glands (cf. **chapter 6.3**)
- A version with M8/M12 industry connectors located on a connection board. The pin assignment is described in **chapter 6.4**.
- A version with EtherCAT® interface. More information can be found in **chapter 6.5**.

6.2 Standard version

The interfaces of the ECOMPACT® are by default designed as PCB plug connectors. For connecting the ECOMPACT® the connector housing cover has to be opened. Fig. 6.1 shows the view to the connectors after opening the cover.

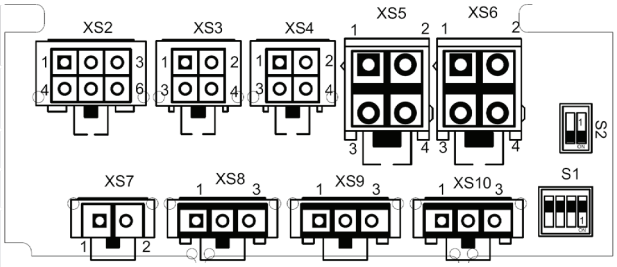
Danger of injury when unplugging the PCB plug connectors.
Observe that the connectors have to be unlocked before removing.
Unlock by pressing the locking lever.
Grip the connectors only at their housing (not at the cable).
Not observing these precautions can result in injuries or damages.

For the interfaces XS2 to XS10 a mating connector set is available (cf. table 9.1 „Original accessories ECOMPACT®“). To simplify the handling all mating connectors are labelled.

6.2.1 Overview of all connectors

Table 6.1: Assignment of the PCB plug connectors

Con-nector	Assignment
XS2	Digital outputs OUT1, OUT2, Enable 1
XS3	CAN bus interface 1
XS4	CAN bus interface 2
XS5	Power supply (max. 60 V) + logic supply (24 V)
XS6	Power supply (max. 60 V) + logic supply (24 V)
XS7	Enable 2 or digital input 1
XS8	Digital input CWI: Positive limit position
XS9	Digital input CCWI: Negative limit position
XS10	Digital input HOME: Reference switch
S1	DIP switch for setting the device address (CAN ID)
S2	DIP switch for internal deactivation of the restart lock (Enable inputs)



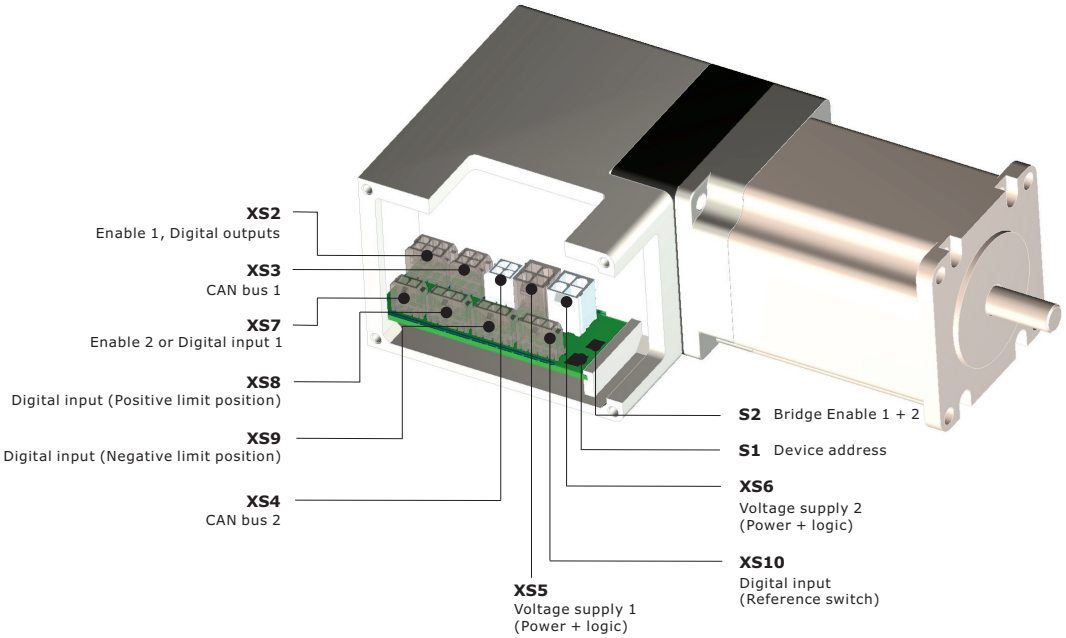


Fig. 6.1: Order of the PCB plug connectors of the ECOMPACT® with connector housing cover opened

Set the device address at DIP switch S1 and if required Enable bridges at DIP switch S2 before connecting the cables because S1 and S2 might be accessible difficultly afterwards. When setting the DIP switches be careful that no surrounding components or cables are damaged by supporting tools such as small screwdrivers.

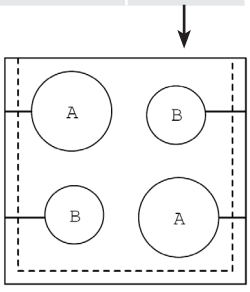
6.2.2 Cable pre-assembling and cable feed-through (cable sleeves)

Pre-assembled cables are available for ECOMPACT®. Optionally the cables can be pre-assembled by the customer. For this purpose, a mating connector set is available. For cable feed-through cable sleeves are used by default. As an option, cable glands (M16 x 1,5) are available as well (cf. chapter 6.3).
Table 6.2 lists the appropriate mating connector type, the pre-assembled cable type and the appropriate cable sleeve diameter for all PCB plug connectors.

Make sure that only cable sleeve diameters (A or B, cf. table) are used which are appropriate for the respective cable diameter. Otherwise protection class IP40 cannot be guaranteed.

Table 6.2: Cable and connector data

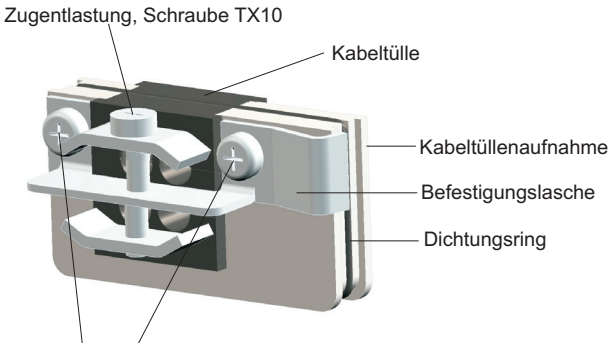
Con-nector	Interface	Mating connector, JAT designation	Cable type JAT designation	Cable sleeve Ø
XS2	Digital outputs OUT1, OUT2, Enable 1	Molex Micro-Fit 3.0	DAT36-833-100-003-000	A or B
XS3	CAN bus bridge	Molex Micro-Fit 3.0	DAT30-832-832-003-000	A
XS4	CAN bus interface	Molex Micro-Fit 3.0	DAT30-832-412-003-000	A
XS5	Power supply (max. 60 V) + logic supply (24 V) bridge	Molex Mini-Fit Jr.	NET43-820-820-003-000	A
XS6	Power supply (max. 60 V) + logic supply (24 V)	Molex Mini-Fit Jr.	NET43-820-100-003-000	A
XS7	Enable or Digital input 1	Molex Micro-Fit 3.0	DAT35-830-100-003-000	B
XS8	Digital input CWI: Positive limit position	Molex Micro-Fit 3.0	SNS35-831-100-003-000	B
XS9	Digital input CCWI: Negative limit position	Molex Micro-Fit 3.0	SNS35-831-100-003-000	B
XS10	Digital input HOME: Reference switch	Molex Micro-Fit 3.0	SNS35-831-100-003-000	B



For feeding-through the pre-assembled cables proceed as follows:

1. Specify the direction the cables are intended to be fed through the ECOMPACT® housing. Prefered direction of the power supply cable is to the front. The control signal cables should be fed to the side.

2. Remove the respective cable sleeve accomodation by pulling it upwards.
The following figure shows the removed cable sleeve accomodation.



3. Remove the sealing ring at the outer edge.

4. Loosen the two Torx screws (TX10) and retrieve the cable sleeve including the mounting lug.

5. Loosen the screw at the strain relief.

6. Open the cable sleeve outlet(s) to be used.

7. Feed the cable through the slot at the side of the cable sleeve into the respective outlet.

8. Pull the cable back to the strain relief. Observe that the cable shield is well connected to the strain relief.

9. Tighten up the screw at the strain relief.

10. Re-insert the cable sleeve into the cable sleeve accomodation and screw on the mounting lug using the two Torx screws (TX10).

11. Re-insert the sealing ring into the cable sleeve accomodation.

12. Connect the protective earth line (PE) of the power supply cable to the connector housing (cf. Chap. 5.1.3, Fig. 5.2).

13. Plug the cable connectors to the respective PCB plug connectors

14. Re-insert the cable sleeve accomodation into the housing of the ECOMPACT®.

6.2.3 Control signals

6.2.3.1 XS2, XS7: Digital outputs (24V), Enable inputs

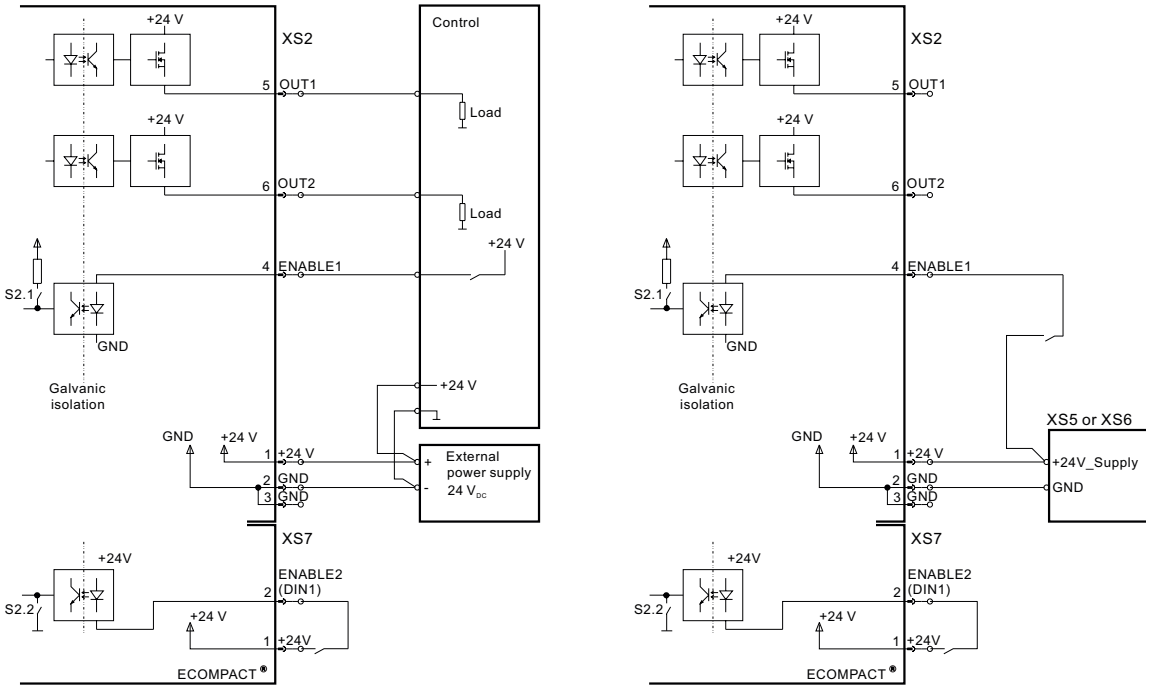
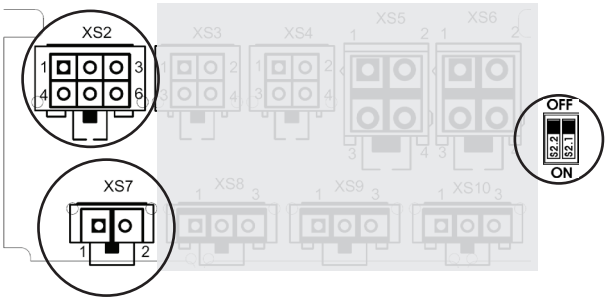


Fig. 6.2: Connector XS2, XS7: Circuit of the digital outputs and Enable inputs: *- left side: Operation with external control*
- right side: Operation without external control

Version xxExx-0xx-xxx-BA-Cx-xxx-xxx

Table 6.4a: Pin assignment of the digital outputs and ENABLE inputs, wire colours of standard cables

Signal	Conn.	Pin	Description
OUT1	XS2	5 yellow	Status output ENABLE 2 $I_{O\,max}$ = 0.2 A, isolated
+24V_EXT	XS2	1 white	External reference potential +24V
OUT2	XS2	6 grey	Digital output 2 I_{Omax} = 0.2 A, isolated
GND	XS2	2, 3 brown	Reference potential GND
ENABLE 1	XS2	4 green	Enable 1
ENABLE 2	XS7	2 brown	Enable 2
+24V_EXT	XS7	1 white	Reference pot. +24V Enable 2

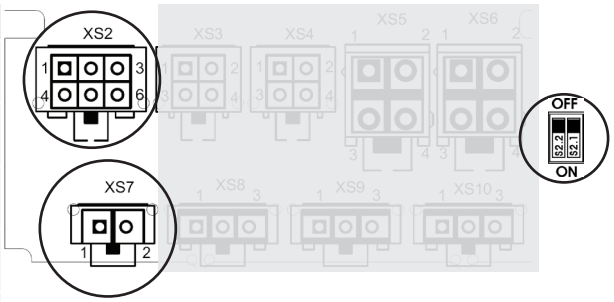


In the version xxExx-0xx-xxx-B**A**-Cx-xxx-xxx the ECOMPACT® provides two hardware enable inputs which both have to be activated in order to switch the ECOMPACT® operational (cf. chapter 6.2.5.1, restart lockout). Enable input 1 is activated by supplying a voltage of + 24 V (HIGH). Enable input 2 is activated by jumpering the both pins at XS7. By means of the DIP switch S2 the enable can be forced („ON“ position), e.g. for testing purposes or if no hardware enable signal should be used. S2.1 is assigned to enable input 1, S2.2 is assigned to enable input 2. The status of enable input 2 is directly switched through to the status output OUT1.

Version xxExx-0xx-xxx-BB-Cx-xxx-xxx

Table 6.4b: Pin assignment of the digital outputs and ENABLE inputs, wire colours of standard cables

Signal	Conn.	Pin	Description
OUT1	XS2	5 yellow	Digital output 1 $I_{O\,max}$ = 0.2 A, isolated
+24V_EXT	XS2	1 white	External reference potential +24V
OUT2	XS2	6 grey	Digital output 2 I_{Omax} = 0.2 A, isolated
GND	XS2	2, 3 brown	Reference potential GND
ENABLE 1	XS2	4 green	Enable 1
DIN 1	XS7	2 brown	Digital input
+24V_EXT	XS7	1 white	Reference pot. +24V DIN1



In the ECOMPACT® version xxExx-0xx-xxx-B**B**-Cx-xxx-xxx only Enable 1 is available, XS7 can be used as free programmable digital input DIN1. OUT1 can be used as free programmable digital output.

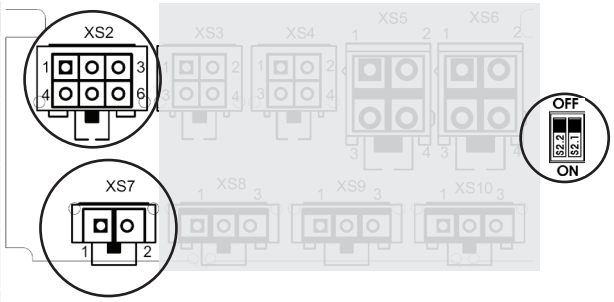
By means of the DIP switch S2.1 the enable can be forced („ON“ position), e.g. for testing purposes or if no hardware enable signal should be used.

DIP switch S2.2 has to be in the „OFF“ position in order to switch through the signals at digital input XS7.

Version xxExx-0xx-xxx-BC-Cx-xxx-xxx

Table 6.4a: Pin assignment of the digital outputs and ENABLE inputs, wire colours of standard cables

Signal	Conn.	Pin	Description
OUT1	XS2	5 yellow	Digital output 1 $I_{O\,max}$ = 0.2 A, isolated
+24V_EXT	XS2	1 white	External reference potential +24V
OUT2	XS2	6 grey	Digital output 2 I_{Omax} = 0.2 A, isolated
GND	XS2	2, 3 brown	Reference potential GND
ENABLE 1	XS2	4 green	Enable 1
ENABLE 2	XS7	2 brown	Enable 2
+24V_EXT	XS7	1 white	Reference pot. +24V Enable 2

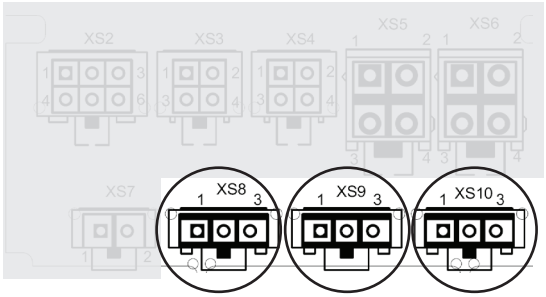


In the version xxExx-0xx-xxx-B**C**-Cx-xxx-xxx the ECOMPACT® provides two hardware enable inputs which both have to be activated in order to switch the ECOMPACT® operational (cf. chapter 6.2.5.1, restart lockout). Enable input 1 is activated by supplying a voltage of + 24 V (HIGH). Enable input 2 is activated by jumpering the both pins at XS7. By means of the DIP switch S2 the enable can be forced („ON“ position), e.g. for testing purposes or if no hardware enable signal should be used. S2.1 is assigned to enable input 1, S2.2 is assigned to enable input 2. **OUT1 and OUT2 can be used as free programmable digital outputs.**

6.2.3.2 XS8, XS9, XS10: Digital inputs for limit switches and reference switch

Table 6.5: Pin assignment of the digital inputs, wire colours of standard cables (3x)

Signal	Conn.	Pin	Wire colour	Description
+24V	XS8	1	white	Reference potential +24V
CWI (DIN3)	XS8	2	green	Positive limit position
GND	XS8	3	brown	Reference potential GND
+24V	XS9	1	white	Reference potential +24V
CCWI (DIN4)	XS9	2	green	Negative limit position
GND	XS9	3	brown	Reference potential GND
+24V	XS10	1	white	Reference potential +24V
HOME (DIN5)	XS10	2	green	Reference switch
GND	XS10	3	brown	Reference potential GND



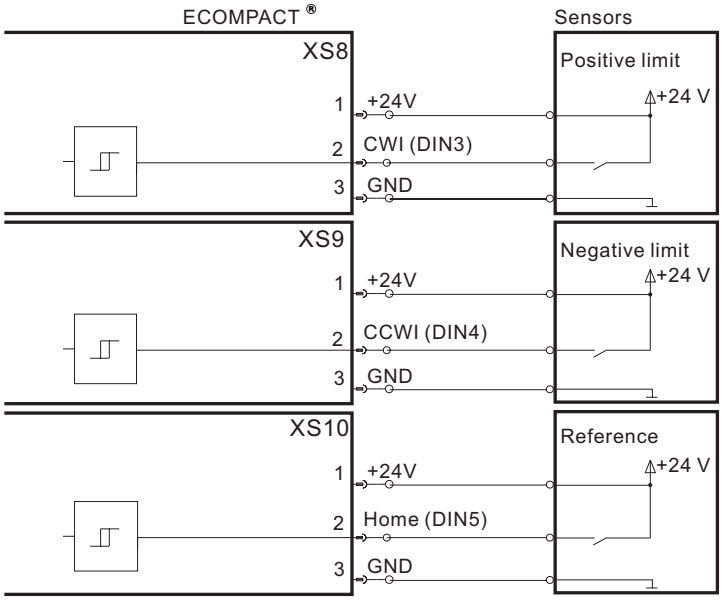
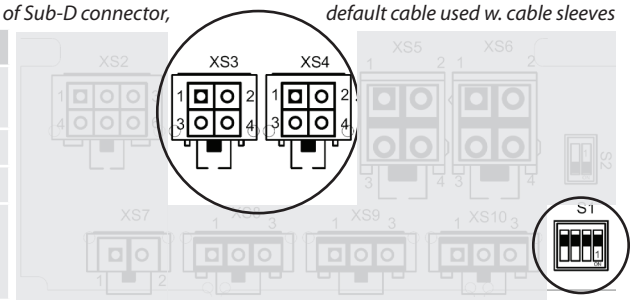


Fig. 6.3 Connector XS8, XS9, XS10: Circuit of the digital inputs for limit switches and reference switch

6.2.3.3 XS3, XS4: CAN interface

Table 6.6: Pin assignment connector XS3, XS4, pin assignment of Sub-D connector, default cable used w. cable sleeves

Signal	Pin	Pin Sub-D	Description
CAN_V+	1	9 (white)	+24 V_{DC} (+8 – +30 V_{DC}), max. 50 mA
CAN_H	2	7 (green)	CAN data H
CAN_L	3	2 (yellow)	CAN data L
CAN_GND	4	3 (brown)	Reference potential for CAN_V+



The connectors XS3 and XS4 can be used equivalently. The signals are looped through, thus the CAN bus can be connected to another ECOMPACT®. For reasons of clearness XS4 should be used for the incoming CAN bus from the CAN master, and XS3 should be used for the transfer to other devices.

The ECOMPACT® CAN interface is based on the communication profile CiA DS 301 and on the device profile CiA DSP 402 (drives and motion control). It must be supplied with external voltage. Terminating resistors are not built in the ECOMPACT®. A CAN bus has to be terminated with a 120 Ω resistor at the beginning and at the end. If the ECOMPACT® is operated as first or last participant at a CAN bus, a 120-Ω terminating resistor (as part of the mating connector set, cf. Chap. 9) is used at XS3 between the pins 2 and 3 (cf. Fig. 6.5).

The device address is set via the binary coding of the DIL switch S1. If all switches are in the „0“ position, the node ID is 0x7F. The Baud rate and the node ID can be set directly via the appropriate CAN objects.

The following Baud rates are supported: 1 000 kBit/s, 500 kBit/s, 250 kBit/s, 125 kBit/s, 100 kBit/s, 50 kBit/s. If point of sampling and scan rate (86.7 %, 3-times sampling at all Baud rates) do not meet the demands please get in touch with the technical service of Jenaer Antriebstechnik.

In the ECOMPACT® with EtherCAT® option (chapter 6.5) the connectors XS3 and XS4 cannot be used as external CAN interface.

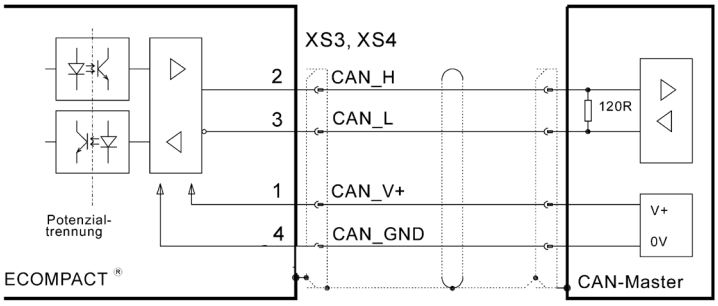


Fig. 6.4: Circuit XS3, XS4: CAN interface

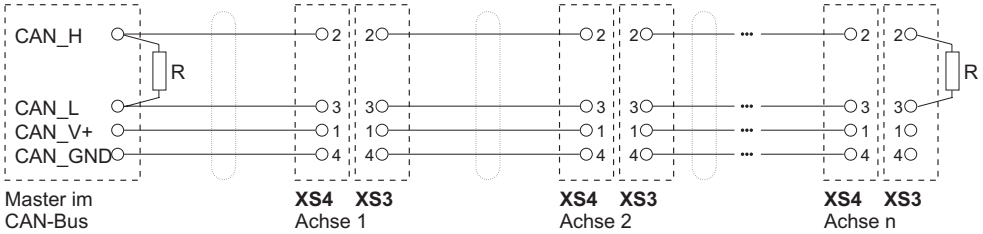


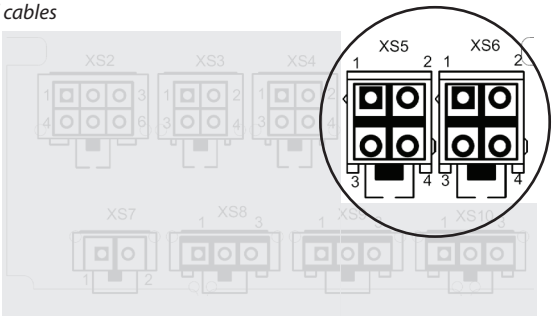
Fig. 6.5: Size terminating resistors R according to line impedance; normal: R = 120 Ω

6.2.4 Power connection

6.2.4.1 XS5, XS6: DC link voltage, logic supply

Table 6.7: Pin assignment connector XS5, XS6, wire colours of standard cables

Signal	Pin	Wire colour	Description
GND	1	brown	Reference ground
DC+	2	orange	+ DC link (power supply)
GND	3	black	Reference ground
+24V_Supply	4	red	Logic supply
PE*		green/yellow	Protective earth
*) connected to the housing, cf. chapter 5.1.3, Fig. 5.2			



The connector XS5 is used for direct DC supply. Furthermore, the logic circuit (+24V) which is separate from the power circuit is supplied here.

The connectors XS5 and XS6 are looped through, thus the supply voltages can be fed to another ECOMPACT® via XS6.

In case of direct DC supply of the DC link circuit, the inrush current is not limited by the servo drive. Therefore, special limitation measures have to be taken in the external power supply unit. If energy is regenerated, the power unit must be equipped with a ballast circuit in case the regenerated energy is higher than the

6.2.5 Safety functions

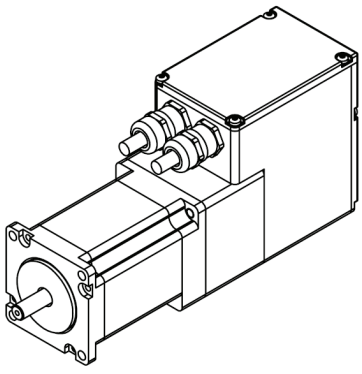
6.2.5.1 Restart lock

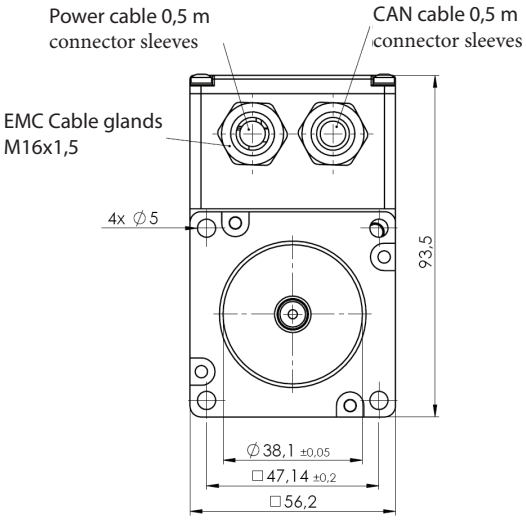
The ECOMPACT® provides a redundant restart lock which can be implemented by two independent input contacts ENABLE 1 (connector XS2) and ENABLE 2 (connector XS7). Optionally the restart lock can also be configured via only *one* ENABLE input, the other is then free for other purposes. In case of an error the drive is switched off, i.e. the power stage is switched off and the holding brake, if any, is activated. The error is signalled and an emergency telegram is sent via the CAN bus. The device can be switched on again only if the error condition is cleared and if the hardware enable inputs are activated.

Relevant aspects of safety
See also the prescribed use of the compact servo drive ECOMPACT® described in Chap. 2.3 and the operating conditions mentioned there.
If the restart lock is active, the inputs ENABLE 1 and ENABLE 2 set all driver transistors into high resistance state. This is a hardware function for both inputs. The control of the feedback contact is a software function. Also in case of an error, if a current in the motor is produced by damaged driver transistors the high-pole servo motor cannot start because the necessary rotating field is not created.

6.3 Version with protection class IP54

As an option, a version of the ECOMPACT with protection class IP54 is available. Here, the CAN bus interface (incoming and outgoing), power supply +24 ... +60 V_{DC}, and logic supply +24 V_{DC} are provided via cable glands. The cables of 0.5 m length are equipped with connector sleeves.





For connecting the ECOMPACT version with protection class IP54 it is not necessary to open the housing!

6.3.1 CAN interface

The ECOMPACT® CAN interface is based on the communication profile CiA DS 301 and on the device profile CiA DSP 402 (drives and motion control). The signals are looped through, thus the CAN bus can be connected to another ECOMPACT®. The interface must be supplied with external voltage. Terminating resistors are not built in the ECOMPACT®. A CAN bus has to be terminated with a 120 Ω resistor at the beginning and at the end. If the ECOMPACT® is operated as first or last participant at a CAN bus, a 120-Ω terminating resistor (as part of the mating connector set, cf. Chap. 9) is used at XS3 between the pins 2 and 3 (cf. Fig. 6.5).

Table 6.8: Wire assignment CAN interface

Signal	Colour	Description
CAN_V+	white	+24 V_{DC} (+8 – +30 V_{DC}), max. 50 mA
CAN_H in	green	CAN Data H incoming
CAN_L in	yellow	CAN Data L incoming
CAN_H out	grey	CAN Data H outgoing
CAN_L out	pink	CAN Data L outgoing
CAN_GND	brown	Reference potential for CAN_V+

The Baud rate and the node ID can be set directly via the appropriate CAN objects.

The following Baud rates are supported: 1 000 kBit/s, 500 kBit/s, 250 kBit/s, 125 kBit/s, 100 kBit/s, 50 kBit/s. If point of sampling and scan rate (86.7 %, 3-times sampling at all Baud rates) do not meet the demands please get in touch with the technical service of Jenaer Antriebstechnik.

6.3.2 Power supply, logic supply

The power cable is used for direct DC supply. Furthermore, the logic circuit (+24V) which is separate from the power circuit is supplied here.

Table 6.9: Wire assignment power supply, logic supply

Signal	Wire colour	Description
GND	brown	Reference ground
DC+	orange	+ DC link (power supply)
GND	black	Reference ground
+24V_Supply	red	Logic supply
PE	green/yellow	Protective earth

In case of direct DC supply of the DC link circuit, the inrush current is not limited by the servo drive. Therefore, special limitation measures have to be taken in the external power supply unit. If energy is regenerated, the power unit must be equipped with a ballast circuit in case the regenerated energy is higher than the energy consumed by all consumers connected to the DC bus.

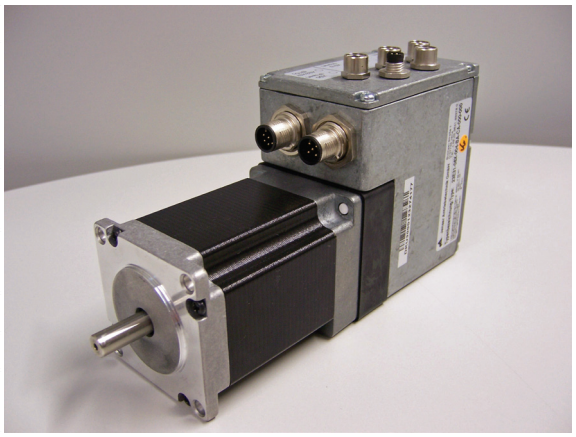
6.4 Version with M8/M12 connectors with CAN interface

As an option, a version of the ECOMPACT with M8 and M12 connectors is available.

6.4.1 Overview of all connectors

Table 6.10: Connectors M8/M12

Connector		Description
CANin	M8 male	CAN bus interface in
CANout	M8 female	CAN bus interface out
Power	M12 male	Power supply (max. 60 V) + logic supply (24 V)
Din/Dout	M12 male	Digital outputs OUT1, OUT2, Enable 1 + 2
CWI	M8 female	Digital input CWI: Positive limit position
CCWI		Digital input CCWI: Negative limit position
Ref/ Home		Digital input HOME: Reference switch



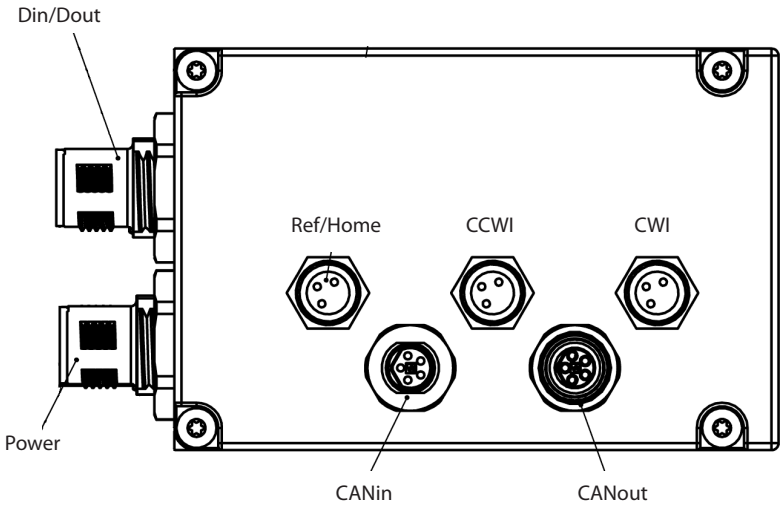


Fig. 6.6: Layout of the ECOMPACT® connectors (option M8/M12)

Information concerning the appropriate cables can be found in chapter 6.4.4.

6.4.2 Control signals

6.4.2.1 Connector Din/Dout: Digital outputs (24V), Enable inputs

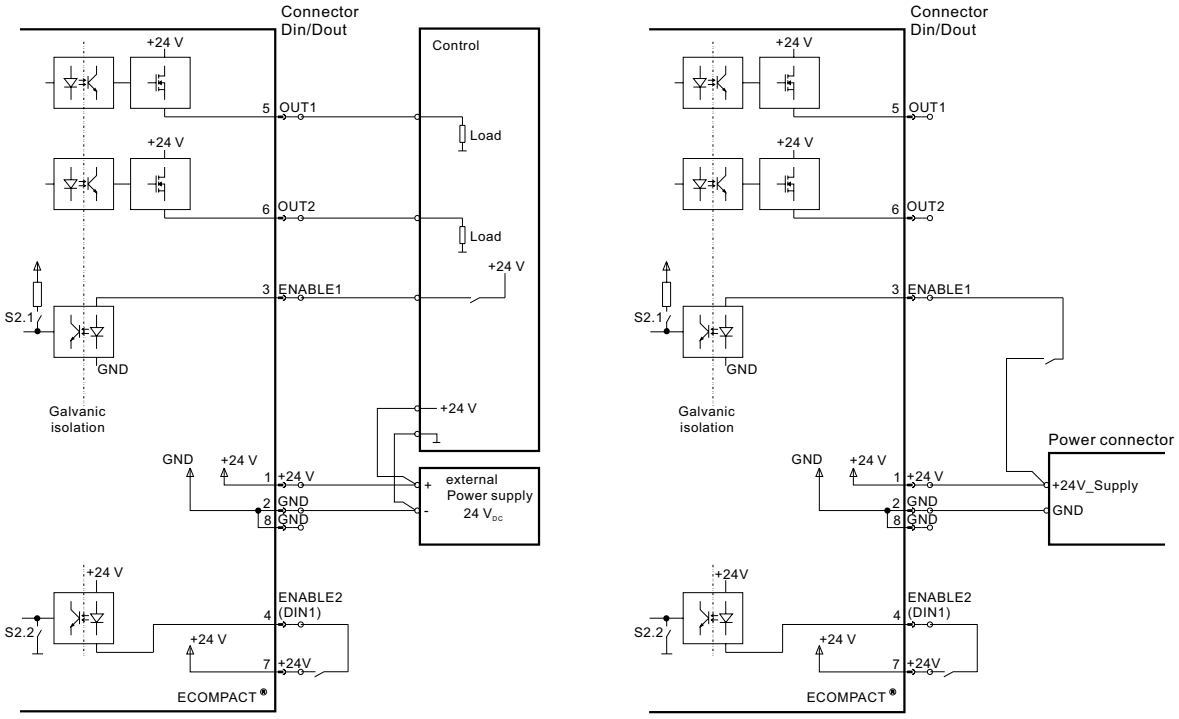
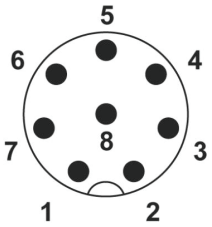


Fig. 6.7: Connector Din/Dout: Circuit of the digital outputs and Enable inputs: - left side: Operation with external control - right side: Operation without external control

Version xxExx-0xx-xxx-B<u>A</u>-Cx-xxx-xxx

Table 6.11: Pin assignment of the digital outputs and ENABLE inputs (M12 connectors)

Pin	Signal	Description
1	+24V_EXT	External reference potential +24V
2	GND_EXT	Reference potential GND
3	ENABLE 1	Enable 1
4	ENABLE 2	Enable 2
5	OUT1	Status output ENABLE 2 $I_{O\,max}$ = 0.2 A, isolated
6	OUT2	Digital output 2 I_{Omax} = 0.2 A, isolated
7	+24V_EXT	Reference potential +24V Enable 2
8	GND_EXT	Reference potential GND

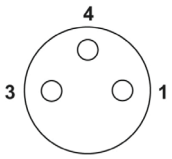


In the version xxExx-0xx-xxx-B**A**-Cx-xxx-xxx the ECOMPACT® provides two hardware enable inputs which both have to be activated in order to switch the ECOMPACT® operational (cf. chapter 6.2.5.1, restart lockout). Enable input 1 is activated by supplying a voltage of + 24 V (HIGH). Enable input 2 is activated by jumpering the pins 7 and 4. The status of enable input 2 is directly switched through to the status output OUT1.

6.4.2.2 CWI, CCWI, Ref/Home: Digital inputs for limit switches and reference switch

Table 6.12: Pin assignment of the sensor inputs ECOMPACT® (M8 female connector)

Connector	Pin	Signal	Description
CWI	1	+24V	Reference potential +24V
	3	GND	Reference potential GND
	4	CWI (DIN3)	Positive limit position
CCWI	1	+24V	Reference potential +24V
	3	GND	Reference potential GND
	4	CCWI (DIN4)	Negative limit position
Ref/Home	1	+24V	Reference potential +24V
	3	GND	Reference potential GND
	4	HOME (DIN5)	Reference switch



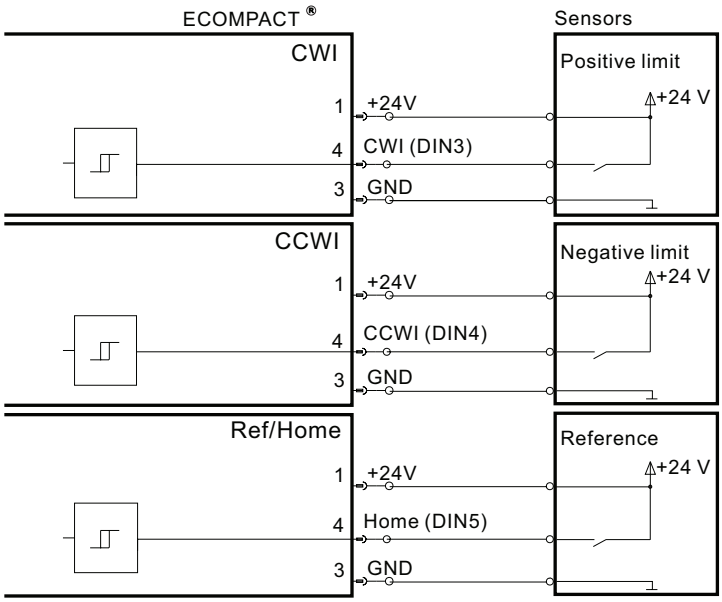
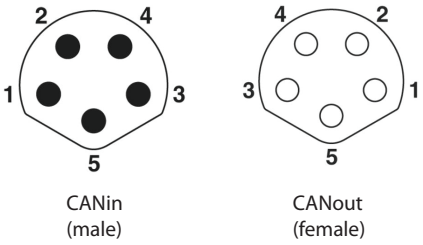


Fig. 6.8 Connectors CWI, CCWI, Ref/Home: Circuit of the digital inputs for limit switches and reference switch

6.4.2.3 CANin, CANout: CAN interface

Table 6.13: Pin assignment CANin, CANout (M8 connectors)

Pin	Signal	Description
1	Shield	
2	CAN_V+	+24 V_{DC} (+8 – +30 V_{DC}), max. 50 mA
3	CAN_H	CAN Data H
4	CAN_GND	Reference potential CAN_V+
5	CAN_L	CAN Data L



The connectors CANin and CANout can be used equivalently. The signals are looped through, thus the CAN bus can be connected to another ECOMPACT®. For reasons of clearness CANin should be used for the incoming CAN bus from the CAN master, and CANout should be used for the transfer to other devices.

The ECOMPACT® CAN interface is based on the communication profile CiA DS 301 and on the device profile CiA DSP 402 (drives and motion control). It must be supplied with external voltage. Terminating resistors are not built in the ECOMPACT®. A CAN bus has to be terminated with a 120 Ω resistor at the beginning and at the end. If the ECOMPACT® is operated as first or last participant at a CAN bus, a 120-Ω terminating resistor (male connector type Phoenix Contact SAC-5P-M 8MS DN TR) is used (cf. Fig. 6.9).

The Baud rate and the node ID can be set directly via the appropriate CAN objects.

The following Baud rates are supported: 1 000 kBit/s, 500 kBit/s, 250 kBit/s, 125 kBit/s, 100 kBit/s, 50 kBit/s. If point of sampling and scan rate (86.7 %, 3-times sampling at all Baud rates) do not meet the demands please get in touch with the technical service of Jenaer Antriebstechnik.

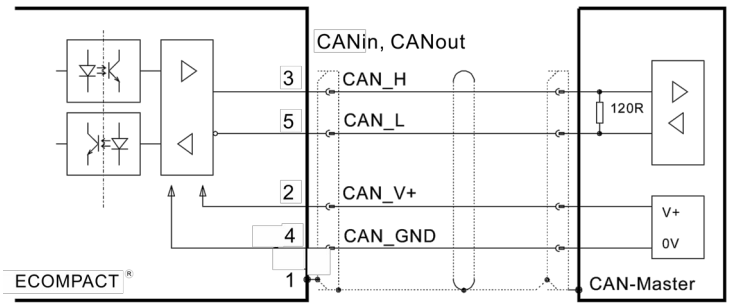


Fig. 6.9: Interface CANin, CANout

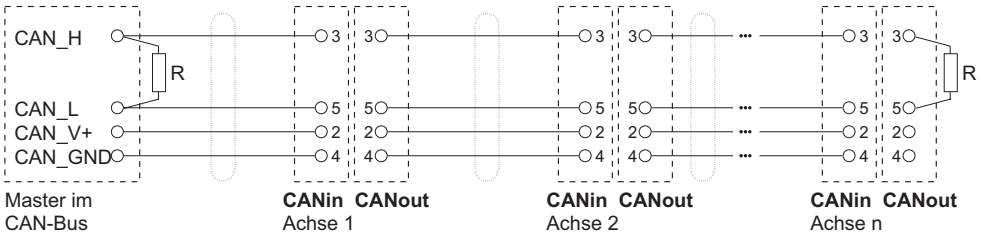


Fig. 6.10: Size terminating resistors R according to line impedance; normal: R = 120 Ω

6.4.3 Power connection

6.4.3.1 Power connector: DC link voltage, logic supply

Table 6.14: Pin assignment Power (M12 connector)

Pin	Signal	Description
1	DC+	+ DC link (power supply 24 ... 60 V_{DC})
2	GND	Reference ground
3	+24V_Supply	Logic supply 24 V_{DC}
4	PE	Protective earth

The „Power“ connector is used for direct DC supply. Furthermore, the logic circuit (+24V) which is separate from the power circuit is supplied here.

In case of direct DC supply of the DC link circuit, the inrush current is not limited by the servo drive. Therefore, special limitation measures have to be taken in the external power supply unit. If energy is regenerated, the power unit must be equipped with a ballast circuit in case the regenerated energy is higher than the energy consumed by all consumers connected to the DC bus.

6.4.4 Appropriate cables incl. mating connector

Table 6.15: Appropriate cables incl. mating connector

Connector	Interface	Cable type (incl. mating connector)	Description
Din/Dout	Digital outputs OUT1, OUT2, Enable 1 + 2	e.g. Phoenix Contact SAC-8P- 3,0-PUR/M12FS	Sensor/actor cable, 30V, 2A M8 Bu / free wire ends, 8-pole, cable length: 3m
CANin, CANout	CAN bus *	e.g. Phoenix Contact SAC-5P-M 8MS/ 2,0-920/M 8FS	Bus system cable, CANopen, shielded, M8 male to female, 5-pole, cable length: 2 m
Power	Power supply (max. 60 V) + Logic supply (24 V)	e.g. Phoenix Contact SAC-4P-FSS/ 1,5-PUR PE SH SCO	Sensor/actor cable, 60V, 4A M12 female / free wire ends , 4-pole, cable length: 3m
CWI	Digital input CWI: positive limit position	e.g. Phoenix Contact SAC-3P-M 8MS/ 2,0-PUR/M 8FS	Sensor/actor cable M8 male to female, 3-pole, cable length: 2 m
CCWI	Digital input CCWI: negative limit position	e.g. Phoenix Contact SAC-3P-M 8MS/ 2,0-PUR/M 8FS	Sensor/actor cable M8 male to female, 3-pole, cable length: 2 m
Ref/Home	Digital input HOME: reference switch	e.g. Phoenix Contact SAC-3P-M 8MS/ 2,0-PUR/M 8FS	Sensor/actor cable M8 male to female, 3 pole, cable length: 2 m

*) Termination resistor for CAN bus: Phoenix Contact SAC-5P-M 8MS DN TR (M8 male, 5-pole)

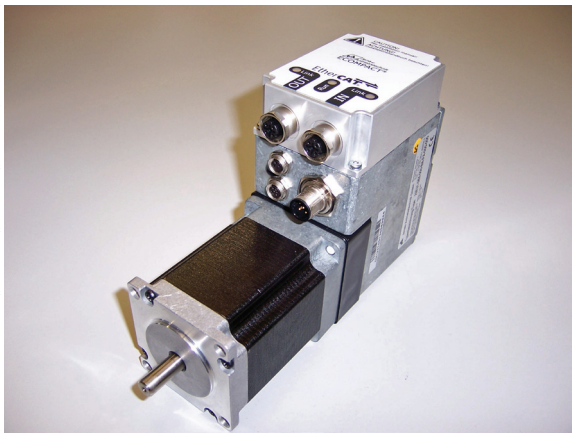
6.5 Version with M8/M12 connectors with EtherCAT interface

The version of the ECOMPACT with EtherCAT interface is only available with M8 and M12 connectors.

6.5.1 Overview of all connectors

Table 6.16: Connectors of the EtherCAT version

Connector		Description
EtherCAT IN	M12 female	Incoming EtherCAT interface
EtherCAT OUT	M12 female	Outgoing EtherCAT interface
Power	M12 male	Power supply (max. 60 V) + logic supply (24 V)
Din/Dout	M8 male	Digital outputs OUT1, OUT2, Enable 1 + 2
Ref/ Home	M8 female	Digital input HOME: Reference switch



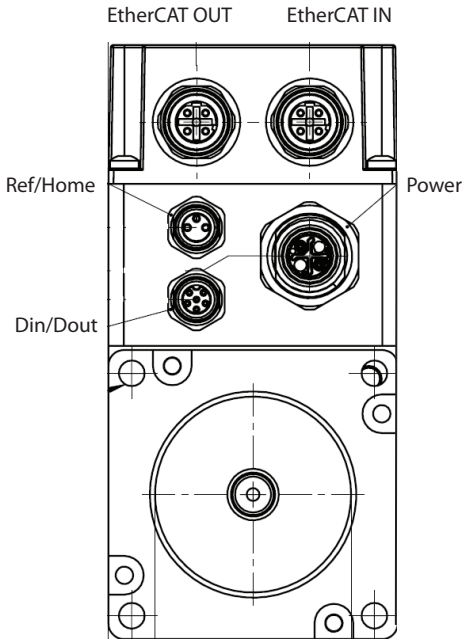


Fig. 6.11: Layout of the ECOMPACT® connectors (option with EtherCAT interface)

Information concerning the appropriate cables can be found in chapter 6.5.4.

6.5.2 Control signals

6.5.2.1 Connector Din/Dout: Digital outputs (24V), Enable inputs

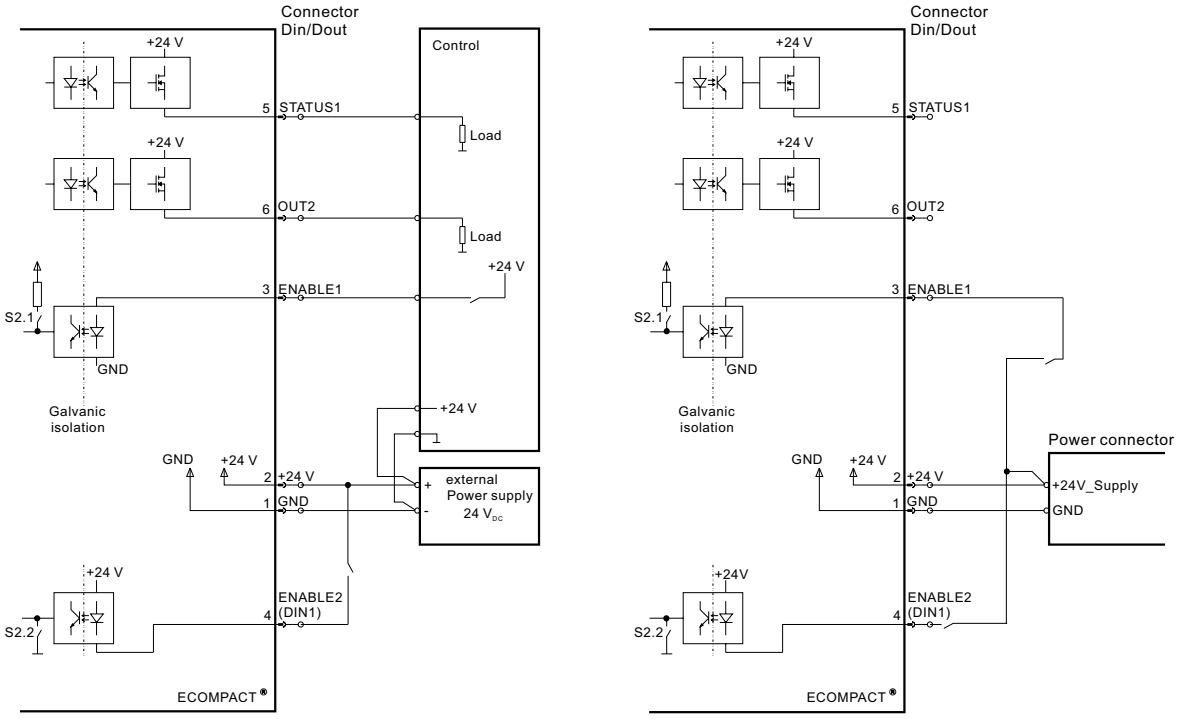
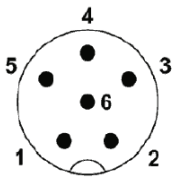


Fig. 6.12: Connector Din/Dout: Circuit of the digital outputs and Enable inputs: - left side: Operation with external control
- right side: Operation without external control

Version xxExx-0xx-xxx-B<u>A</u>-Px-xxx-xxx

Table 6.17: Pin assignment of the digital outputs and ENABLE inputs (M8 connector)

Pin	Signal	Description
1	GND_EXT	Reference potential GND
2	+24V_EXT	External reference potential +24V
3	ENABLE 1	Enable 1
4	ENABLE 2	Enable 2
5	STATUS 1	Status output ENABLE 2 $I_{O\,max}$ = 0.2 A, isolated
6	OUT2	Digital output 2 I_{Omax} = 0.2 A, isolated

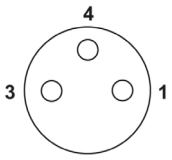


In the version xxExx-0xx-xxx-B**A**-Px-xxx-xxx the ECOMPACT® provides two hardware enable inputs which both have to be activated in order to switch the ECOMPACT® operational (cf. chapter 6.2.5.1, restart lockout). Enable input 1 and Enable input 2 are activated by supplying a voltage of + 24 V (HIGH). The status of enable input 2 is directly switched through to the status output STATUS 1.

6.5.2.2 Ref/Home: Digital input for reference switch

Table 6.18: Pin assignment of the sensor input ECOMPACT® (M8 female connector)

Connector	Pin	Signal	Description
Ref/Home	1	+24V	Reference potential +24V
	3	GND	Reference potential GND
	4	HOME (DIN5)	Reference switch



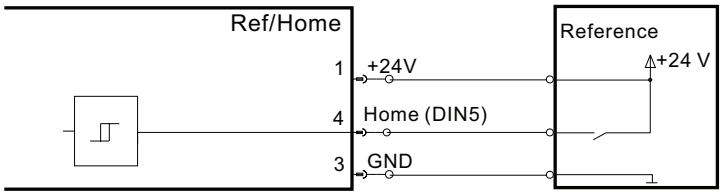
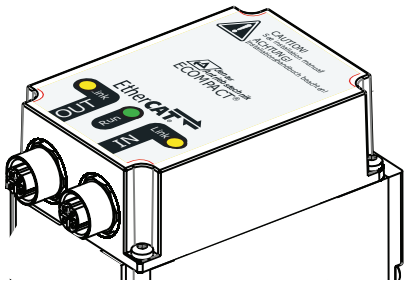


Fig. 6.13 Connector Ref/Home: Circuit of the digital input for reference switch

6.5.2.3 EtherCAT interface

As an option, ECOMPACT® can be equipped with an EtherCAT® interface which can be used for setpoint setting and parameterization. The interface supports the protocol of the EtherCAT® Technology Group and allows for Fast Ethernet according to IEEE-802.3u (100Base-TX), fullduplex, 100Mbps. Physically, the interface is designed as two M12 sockets at the front side of the ECOMPACT®.



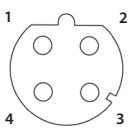


Table 6.19: Pin assignment connector IN, OUT on design with EtherCAT® interface

Pin	Signal	Description
1	TX+	Transmit signal +
2	RX+	Reveive signal +
3	TX-	Transmit signal -
4	RX-	Receive signal -

LED green:

Run

LED green	Clock	Description
off	-	EtherCAT state Init
flashes	5 Hz	EtherCAT state Pre-Operational
flashes	200 ms on/ 1s off	EtherCAT state Safe Operational
on	-	EtherCAT state Operational

LED yellow:

Link/Activity IN or OUT

LED orange	Description
off	No link. Link not sensed (or no power)
on	Link sensed, no traffic detected
flickering	Link sensed, traffic detected

The EtherCAT® „IN“ port is used for the connection to the PC or a server (end of a star-shaped connection).

The EtherCAT® „OUT“ port is intended for the connection to further servo amplifiers via a line-shaped connection (uplink, cf. examples below).

Cabling is done via twisted-pair-cables UTP, Cat.5e, with D-coded M12 connector. The second connector can be RJ45 (appropriate cable type e.g. Phoenix Contact VS-M12MS-IP20-93E-LI/2,0) or M12, respectively (for interconnection between two ECOMPACT®, appropriate cable type e.g. Phoenix Contact SAC-M12MSD/18,0-93E/M12MSD). Tree and line topologies are supported. Star topologies are possible as well. The cable length between two devices is limited to 100 m.

For process control and visualization of EtherCAT® devices the operation with the PC software „TwinCAT“ (manufacturer: Beckhoff GmbH) is proposed. For configuration instructions and an application example please refer to Application Note 26.

The objects which are required for the configuration of the EtherCAT® communication are described in the manual „Object Dictionary ECOVARIO, ECOSTEP, ECOMPACT, chapter 5.2.29.

In the ECOMPACT® with EtherCAT® option the connectors XS3 and XS4 cannot be used as external CAN interface.

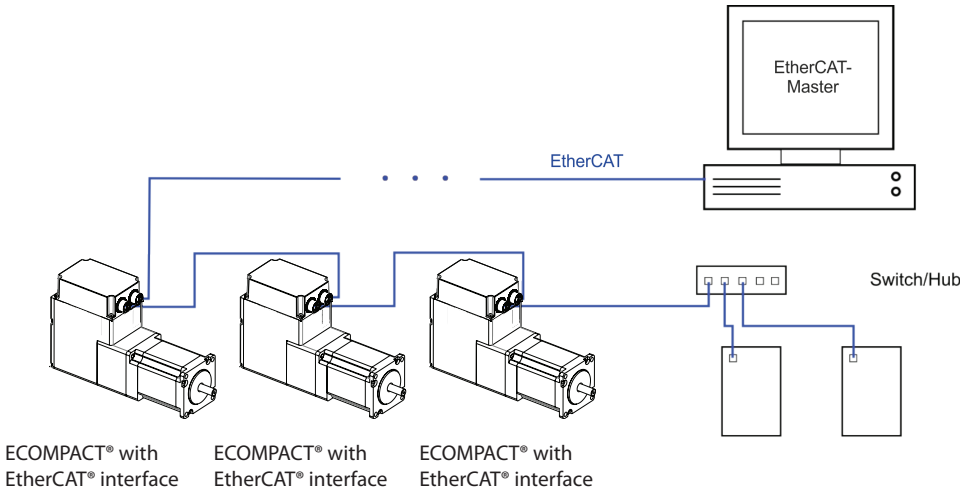


Fig. 6.14: Operation of ECOMPACT® in an EtherCAT® network

6.5.3 Power connection

6.5.3.1 Power connector: DC link voltage, logic supply

Table 6.20: Pin assignment Power (M12 connector)

Pin	Signal	Description
1	DC+	+ DC link (power supply 24 ... 60 V_{DC})
2	GND	Reference ground
3	+24V_Supply	Logic supply 24 V_{DC}
4	PE	Protective earth

The „Power“ connector is used for direct DC supply. Furthermore, the logic circuit (+24V) which is separate from the power circuit is supplied here.

In case of direct DC supply of the DC link circuit, the inrush current is not limited by the servo drive. Therefore, special limitation measures have to be taken in the external power supply unit. If energy is regenerated, the power unit must be equipped with a ballast circuit in case the regenerated energy is higher than the energy consumed by all consumers connected to the DC bus.

6.5.4 Appropriate cables incl. mating connector

Table 6.21: Appropriate cables incl. mating connector

Connector	Interface	Cable type (incl. mating connector)	Description
Din/Dout	Digital outputs OUT1, OUT2, Enable 1 + 2	e.g. Phoenix Contact SAC-6P- 3,0-PUR/M 8FS SH	Sensor/actor cable, 30V, 2A M12 Bu A coded / free wire ends, 6-pole, cable length: 3m
EtherCAT IN, EtherCAT OUT	EtherCAT Master connection	e.g. Phoenix Contact VS-M12MS-IP20-93E-LI/2,0	EtherCAT cable, twisted pair, M12 male to RJ45, 4-pole, cable length: 2 m
	Looping through EtherCAT from ECOMPACT to ECOMPACT	e.g. Phoenix Contact SAC-M12MSD/18,0-93E/M12MSD	EtherCAT cable, twisted pair, M12 male to M12 male, 4-pole, cable length: 18 m
Power	Power supply (max. 60 V) + Logic supply (24 V)	e.g. Phoenix Contact SAC-4P-FSS/ 1,5-PUR PE SH SCO	Sensor/actor cable, 60V, 4A M12 female / free wire ends , 4-pole, cable length: 3m
Ref/Home	Digital input HOME: reference switch	e.g. Phoenix Contact SAC-3P-M 8MS/ 2,0-PUR/M 8FS	Sensor/actor cable M8 male to female, 3 pole, cable length: 2 m

7 Commissioning

7.1 Notes before commissioning

Only qualified personnel with a broad knowlege of the fields of electrical engineering, automation and drives are allowed to commission the compact servo drive ECOMPACT®. If required, Jenaer Antriebstechnik GmbH offers trainings.

The manufacturer of the machine must generate a hazard analysis for the machine and take appropriate measures to ensure that unforeseen movements cannot cause injury or damage to any person or property.

Check the wiring for completeness, short circuit and ground fault.

All live parts must be protected safely against touching.

Never pull the connectors while they are live!

If there are several axes in one machine commission one axis after the other. The axes already commisioned should be switched off.

During operation the temperature of the heat sink and the housing may rise up to over 70 °C. Before touching these parts after switching off the unit wait until the temperature has fallen down to 40 °C.

7.2 Work schedule commissioning

1. Check installation
The compact servo drive is disconnected from the supply. Check the wiring for completeness, short circuits and ground faults.

2. Enable = deactivated
Basic version: Connect signal input ENABLE 1 at connector XS2 to 0 V and open the bridge between pins 1 and 2 of connector XS7 (ENABLE2).
Version with M8/M12 connectors: Connect the signal inputs ENABLE 1 and ENABLE 2 to 0 V.
Note: In the version with protection class IP54 ENABLE is permanently switched on and cannot be deactivated. Proceed with step 3.

3. Switch on 24 V logic supply
Apply the 24 V logic supply to the connector XS5 (***basic version***) or Power (***version with M8/M12 connectors***), pins GND and +24 V.

4. Start setup software
Via a CAN dongle connect a PC to the CAN interface of the ECOMPACT® and start the ECO Studio software. If the ECOMPACT is equipped with an EtherCAT interface (Option), connect it via a network cable to a PC equipped with a network card. Establish the connection to the ECOMPACT®.
Note: If the PC is equipped with more than one network card assignment problems might occur.

5. Device configuration and mechanical configuration

By means of the ECO Studio device configuration wizard and the mechanical configuration wizard carry out the basic settings for the operation of the ECOMPACT®. For a detailed description of software commissioning please refer to the ECO Studio help system.

6. Check safety equipment

Before switching on the voltage it is vital to check if all safety equipment that protects from touching live parts and from the consequences of indeliberate movements functions properly.

7. Zero demand values
Before switching on the power supply the demand values for position and speed should be zeroed.

8. Switch on power supply
The power supply should only be switched on with the on/off switches of a contactor circuit.

9. ENABLE
0,5 s after switching on the power supply, the ENABLE signal can be switched to HIGH (***Basic version:*** 24V level at input XS2: ENABLE1 and bridge between pins 1 and 2 at connector XS7 (ENABLE 2), according to the connection scheme in Chap. 6.2.2.1.)(***Version with M8/M12 connectors:*** 24V level at inputs ENABLE1 and ENABLE 2). In the version with protection class IP54 ENABLE is permanently switched on. If the motor vibrates or hums, first the p-gain of the velocity controller should be reduced (ECO Studio: in the navigation area under Controller, „Velocity Controller“ tab).

10. Optimization

The controller parameters are set to default values by the manufacturer. However, these values have to be checked and adapted to the respective application, if required. Wrong parameter settings can lead to damages of machine parts. A detailed description of the parameterization of the velocity controller and of the position controller can be found in the ECO Studio help system.

7.3 Error messages

If an error is detected, it is displayed by ECO Studio in the „Device Errors“ list.

Table 7.1: Error messages

Error		Measure
Group A	General errors	
A00	Incorrect checksum of a bootloader section or overall checksum	Repeat action, if the error reoccurs, send in device to manufacturer
A01	Error during deleting a flash section	Repeat action, if the error reoccurs, send in device to manufacturer
A02	Error during activating the flash memory	If the error reoccurs, send in device to manufacturer
A03	Error during programming the flash memory	Repeat action, if the error reoccurs, send in device to manufacturer
A04	Error during addressing the flash memory	Repeat action, if the error reoccurs, send in device to manufacturer
A10	Error during reading/writing the EEPROM	If the error reoccurs send in the device to manufacturer
A11	Incorrect checksum of an EEPROM section	Communication and/or application parameters have not (yet) been stored. This behaviour is normal with new devices and has been implemented for signalling this to the user.
A20	Incorrect calibration data	Send in device to manufacturer
A21	Watchdog error of standard loadware	If the error reoccurs send in the device to manufacturer
A23	Loadware does not support this unit	Contact service hotline of Jenaer Antriebstechnik GmbH
Group B	Bus errors	
B00	CAN Nodeguarding error. No messages are sent. Synchronisation window in interpolated mode exceeded.	Check bus connection and device function, check supply voltage of the CAN bus
B01	CAN bus parameters not available, incorrect saving of parameters. No messages are sent	Enter parameters again, check node ID and Baud rate
Group D	Device and axis errors	
D00	Restart lock blocks switch on	Check function of the restart lock
D01	No external enable	Check ENABLE signal
D03	Device temperature > 80 °C	Switch off unit and let it cool down. Make sure that no heat accumulation can occur in the mounting space.
D04	Temperature error motor	
D06	Negative limit position reached	Reset if an error message is raised
D07	Positive limit positon reached	Reset if an error message is raised
D11	Overcurrent in the motor phases	Check motor and supply cables
D12	Exceeding i^2xt limitation of device	Check parameters and operating conditions. Check if axis is freely movable.
D13	Exceeding i^2xt limitation of motor	

Error		Measure
D20	External 24 V supply at XS5/XS6 has fallen below 17 V	Check 24 V power supply. Are there disturbances on the power line? Check output power specification of power supply whether it is dimensioned sufficiently.
D21	DC link voltage too high	Check supply voltage (might be too high)
D22	DC link voltage too low	Check power supply and connections. Check output power specification of power supply whether it is dimensioned sufficiently
D24	Exceeding charging time of DC link	Check voltage
D30	Following error too high	Check axis parameters and operating conditions. Check whether the axis is freely movable.
D31	Commutation not found	Check if axis is freely movable. Check whether the commutation settings are correctly.
D32	Internal software reset	If error reoccurs send in device to manufacturer
D33	Error controller watchdog	If error reoccurs send in device to manufacturer
Group E	Encoder errors	
E00	Correction error of the encoder	If error reoccurs send in device to manufacturer
E01	Capture error of the encoder	If error reoccurs send in device to manufacturer
E02	Interpolation error of the encoder	Error reason might be strong electromagnetical interferences
E03	Too high speed of encoder or cannot be read	Check parameters (overall speed of the motor). Error reason might be contamination or damage of the measuring system.

8 Parameter setting

By setting the parameters the ECOMPACT® is adjusted to the application.
The parameters are set in the PC. The user interface ECO Studio is menu-driven and easy to handle.
The connection PC – ECOMPACT® is established via the CAN interface or via the EtherCAT interface, respectively.

8.1 PC user interface ECO Studio

How to work with the user interface ECO Studio is described in detail in the ECO Studio help system.

9 Accessories

Table 9.1: Survey of ECOMPACT®original accessories

Order key	Description
Complementary parts	
DKK10	Mating connector set Molex (for details cf. Chap. 9.1)
Software tools	
	CD with ECO software tools (e.g. ECO Studio) and documentation
Power supplies	
SV24	1-phase power supply 24 V_{DC}
SV24/60	1-phase power supply 24 V_{DC}, 60 V_{DC}
SV60	1-phase power supply 60 V_{DC}
Cables	
cf. table 9.2	
Cable sleeves	
DKH76	Cable sleeve 2 x Ø 4 mm to 6 mm 2 x Ø 5,5 mm to 7,5 mm

9.1 Mating connector set ECOMPACT® basic version (Molex PCB connectors)

A mating connetor set for all interfaces of the ECOMPACT® is available. All mating connectors are clearly labelled and designed in a way that there is no danger of mixing them up.

Table 9.2: Composition of ECOMPACT® mating connector set DKK10 (standard version)

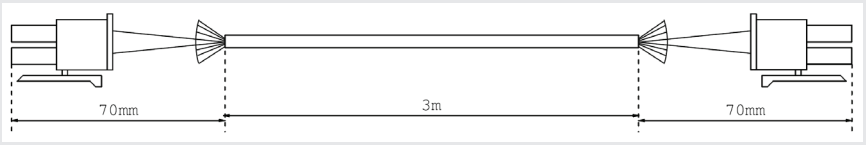
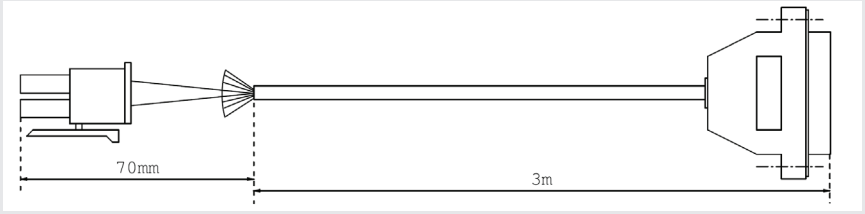
Quantity	Part	Mating connector for	Function
2	4-pole socket housing Molex Mini-Fit Jr.	XS5, XS6	Power supply (max. 60 V) + Logic supply (24 V)
8	Crimp socket AWG 24-18 Molex Mini-Fit Jr.	XS5, XS6	Power supply (max. 60 V) + Logic supply (24 V)
1	2-pole socket housing Molex Micro-Fit 3.0	XS7	Enable 2/Digital input 1
3	3-pole socket housing Molex Micro-Fit 3.0	XS8, XS9, XS10	Digital inputs for limit positions and reference switch
2	4-pole socket housing Molex Micro-Fit 3.0	XS3, XS4	CAN bus interface
1	6-pole socket housing Molex Micro-Fit 3.0	XS2	Digital outputs OUT1, OUT2, Enable 1
25	Crimp socket AWG 20-24 Molex Micro-Fit 3.0	XS2, XS3, XS4, XS7, XS8, XS9, XS10	for all socket housings Molex Micro Fit 3.0
1	Resistor 120 Ω wired		Terminating resisitor for CAN bus
1	Screw DIN7500-CTM3x6:A2K		Protective Earth (PE) connection
1	Serrated lock washer DIN6798 VZ A 3,2		Protective Earth (PE) connection
2	Ring cable lug M3 red		Protective Earth (PE) connection

9.2 Cables for basic version (Molex PCB connectors)

The insulated shield mesh of the cables must be connected to the device potential or the PE conductor resp. If the grounding is improper or the mesh lies freely dangerous voltages may occur. The following table lists the standard cables available for connection of the ECOMPACT®. The cables are further available in the lengths 5 m and 10 m. All cables are equipped with the appropriate mating connectors for the respective PCB plug connectors of the ECOMPACT® interfaces.

Note: Appropriate cables for the M8/M12 connector option are listed in chapter 6.4.4.
Appropriate cables for the EtherCAT® connector option are described in chapter 6.5.4.

Table 9.3: ECOMPACT® accessories, cables

Cable type	Use	Ø [mm]	Wires	Length [m]	min. bending r	Customer Connector
DAT36-833-100-003-000	Digital outputs OUT1, OUT2, Enable 1	Ø = 5.5 mm	5-lead	l = 3 m	r_B = 28 mm	connector sleeves
DAT30-832-832-003-000	Bridging cable CAN bus / terminating resistor	Ø = 6.1 mm	4-lead	l = 3 m	r_B = 46 mm	-
						
DAT30-832-412-003-000	CAN bus	Ø = 6.1 mm	4-lead	l = 3 m	r_B = 46 mm	Sub-D, 9-pol.
						
NET43-820-820-003-000	Bridging cable Power supply (max. 60 V) + Logic supply (24 V)	Ø = 6.4 mm	5-lead	l = 3 m	r_B = 35 mm	-

NET43-820-100-003-000	Power supply (max. 60 V) + Logic supply (24 V)	Ø = 6.4 mm	5-lead	l = 3 m	r_B = 35 mm	connector sleeves

DAT35-830-100-003-000	Enable 2/Digital input 1	Ø = 4.7 mm	2-lead	l = 3 m	r_B = 24 mm	connector sleeves

SNS35-831-100-003-000	Digital input, 1x limit position or reference switch	Ø = 4.7 mm	3-lead	l = 3 m	r_B = 24 mm	connector sleeves

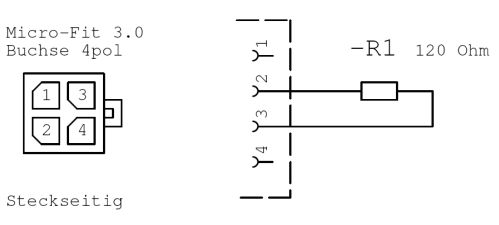
All cables are trailing cables. The PUR sheath is temperature resistant up to 80 °C.

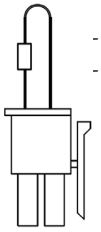
9.3 Establishing the Crimp connections

If cable assembly is done by the customer, the following tool is required for establishing the crimp connections:

- Crimping tool for MOLEX Mini-Fit Jr., 16-24 AWG
- Crimping tool for MOLEX Micro-Fit 3.0, 20-30 AWG

Insertion of the 120 Ω resistor into the mating connector of XS3 (4-pole Micro-Fit 3.0 socket):





- isolate resistor with a shrinkable tube
- arrange resistor vertically

10 Appendix

10.1 Glossary

Ballast circuit	A ballast circuit transforms energy that is fed back into the DC link during braking of a motor into heat. Thus it is made sure that the DC link voltage does not increase too much.
Baud rate	Unit of measure for the transmission rate of data in serial interfaces. The baud rate indicates the number of possible changes of state of the transmitted signal per second (1 baud = 1 state change/s). The baud rate can be lower than the bit rate (one bit is coded in several signal states). „Baud rate“ in this document refers to signals in which one bit is defined with the two signal states HIGH and LOW. In this case the bit rate equals the baud rate.
Bit rate	Transmission rate of information in bit/second
Bootloader mode	State of the servo amplifier in which a new loadware can be transmitted into the servo amplifier‘s memory.
Circuit breaker	Switch that cuts the power if an error current limit is exceeded
DC link voltage	Smoothed DC voltage
Disable	Take back ENABLE signal for the servo amplifier: ENABLE input = 0 V
Encoder	Measuring system, that transforms the angular position of a shaft or the position of a linear system into coded data
EMC	Electromagnetic compatibility
Enable	enable signal for the compact servo drive (24 V_{DC} signal)
ESD protection	Protection against electrostatic discharge
Fieldbus interface	here: CAN
Firmware	Part of the software tha is stored to ROM (read-only memory), the firmware contains the start-up routines.
Ground fault	Here: electrically conductive connection between a power system or motor phase and the PE conductor
ID number	Identification number of a special device in a bus structure
Loadware	Part of the software that can be stored to the flash memory of the device
Node	Device connection in a bus structure
Restart lock	Technical measure that prevents actuators safely by mechanical elements (positively driven contacts) from restarting indeliberately.